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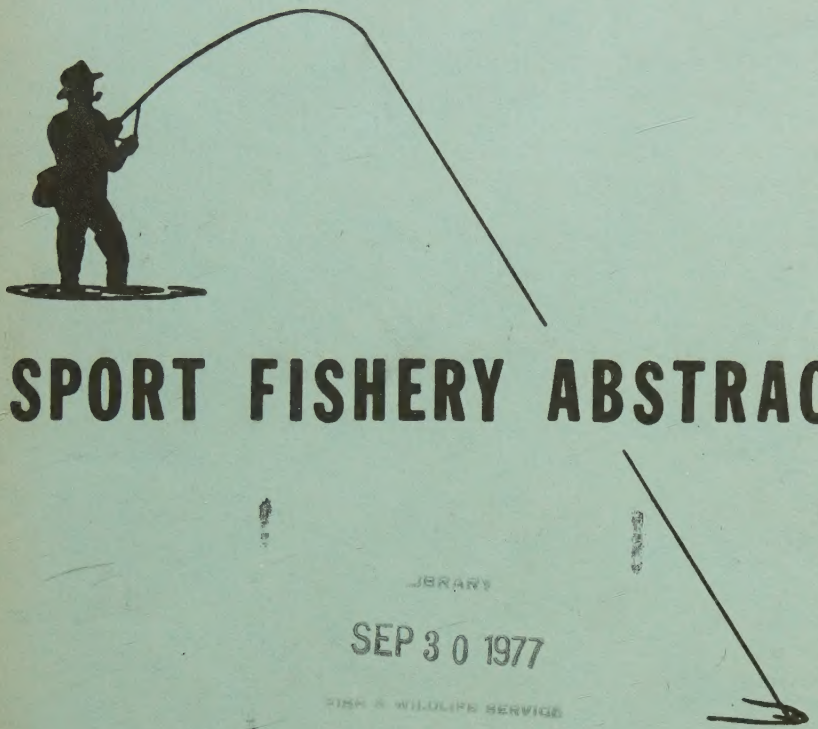

SPORT FISHERY ABSTRACTS

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Fish and Wildlife Service, Lynn A. Greenwalt, Director

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Roger Schoumacher, Editor
Terry N. Sexson, Assistant Editor

Editorial Office
U.S. Fish and Wildlife Service
Aylesworth Hall, CSU
Fort Collins, Colorado 80523

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SPORT FISHERY ABSTRACTS

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AQUATIC PLANTS AND THEIR CONTROL

76-001303 Strange, R. J.; Schreck, C. B. RESPONSE OF AEROBIC COMMUNITY METABOLISM TO CHEMICAL TREATMENT OF AQUATIC MACROPHYTES. J. Aquatic Plant Manage. 14: 45-50. June 1976. SFA 21(4).

[Dep. Fish. Wildl., Oreg. State Univ., Corvallis 97331] Following application of a 6,7-dihydrodipyrido(1,2-/a/:2', 1'-/c/) pyrazidiinium ion (diquat) and 7-oxabicyclo(2,2,1) heptane-2,3-dicarboxylic acid (endothall) herbicide mixture to control the submersed macrophyte egeria (/Egeria densa/ Planch.) in Chichahominy Reservoir, Virginia, daily oxygen consumption by the aquatic community regularly exceeded daily community oxygen production in areas of moderate and heavy macrophyte density. Subsequent recovery aided by phytoplankton increases returned these areas to approximate equilibrium within 6 to 7 weeks. Treatment did not alter the pattern of aerobic community metabolism in an area of light macrophyte growth. Community oxygen consumption 6 weeks after treatment indicated that 24 to 76 percent of the macrophyte biomass lost from the water column in an area of heavy growth may have been aerobically decomposed.

GENERAL FISH CULTURE

76-001304 Johnson, P. W.; Sieburth, J. McN. IN SITU MORPHOLOGY OF NITRIFYING-LIKE BACTERIA IN AQUACULTURE SYSTEMS. Appl. Environ. Microbiol. 31 (3): 423-432. Mar. 1976. SFA 21(4)

[Narragansett Mar. Lab., Univ R.I., Kingston 02881] The in situ microbiota from several aquaculture facilities with active nitrification was examined by transmission electron microscopy of thin sections for the presence of bacteria that contained intracytoplasmic membranes characteristic of the nitrifying bacteria. Colonies of bacteria with the cellular morphology of a species of /Nitrosomonas/ were found to be present in both the culture water and in the biological filter slime of a freshwater chinook salmon (/Oncorhynchus tshawytscha/) culture system. Bacteria in the water possessed the normal nitrosomonas type of ultrastructure, whereas similar bacteria in the slime had an aberrant morphology due to multiple invaginations of the cell wall and cytomembranes and a significantly greater number of ribosomes. These nitrosomonas-like bacteria lysed during enrichment in commonly used media. Bacteria with the morphology of species of /Nitrosomonas/ and /Nitrosococcus/ were also observed in colonies in the surface slimes of marine culture systems for striped bass (/Morone saxatilis/) and quahaug (/Mercenaria mercenaria/).

TROUT AND SALMON CULTURE

76-001305 Bauernfeind, J. C. CANTHAXANTHIN: A PIGMENTER FOR SALMONIDS. Prog. Fish-Cult. 38 (4): 180-183. Oct. 1976. SFA 21(4).
[Hoffmann--La Roche, Inc., Nutley, NJ 07110] The preferred orange, orange-red, or red coloration in the flesh and skin of trout and salmon, which wild fish obtain in their natural food supply, can be achieved by the natural indirect pigmenting process; namely, the addition of a natural stabilized pure oxycarotenoid such as canthaxanthin to the feed. Technically, it has been shown that canthaxanthin introduced into the feed can serve as a replacement product for pigmenting sources which salmonids obtain in the wild. Where legal barriers do not exist, it would appear that canthaxanthin as a feed additive, either alone or in combination with other oxycarotenoids, would be useful in controlling or standardizing the desired flesh and skin color of salmonids under artificial rearing practices.

76-001306 Heard, W. R.; Crone, R. A. RAISING COHO SALMON FROM FRY TO SMOLTS IN ESTUARINE PENS, AND RETURNS OF ADULTS FROM TWO SMOLT RELEASES. Prog. Fish-Cult. 38 (4): 171-174. Oct. 1976. SFA 21(4).
[NOAA, Auke Bay Fish. Lab., Auke Bay, AK 99821] Coho salmon (/Oncorhynchus kisutch/) from 1968 and 1969 broods were raised through the fry, parr, and smolt stages in floating pens in Little Port Walter Bay, southeastern Alaska. They were first raised in low and intermediate salinities in surface-water and later in high-salinity deep water. Average fork lengths and weights of the two groups of smolts were: 1968 brood, 110 mm and 13.5 g; 1969 brood, 106 mm and 11.0 g. The age-I smolts marked and released in the estuary included 261 of the 1968 brood year and 4,000 of the 1969 brood year. Ocean survival from smolt release to adult return to the estuary for these two broods was 12.3 percent and 16.4 percent. Comparisons in size and time of return of adults originating from smolts raised in estuarine pens and from wild smolts from nearby Sashin Creek suggested that the ocean life of the pen-raised fish was normal.

76-001307 Kincaid, H. L. INBREEDING IN RAINBOW TROUT (/SALMO GAIRDNERI). J. Fish. Res. Board Can. 33 (11): 2420-2426. Nov. 1976. In English with French summ. SFA 21(4).
[U.S. FWS, Fish Genet. Lab., Beulah, WY 82712] Effects of inbreeding on rainbow trout (/Salmo gairdneri/) were evaluated by a comparison of differences between inbred and outbred half-sib families reared as contemporaries during the 1st yr of life. Attention was focused on two levels of inbreeding expressed as inbreeding coefficients: F = 0.25, one generation of brother-sister matings, and F = 0.375, two generations of brother-sister matings. Although inbreeding at the F = 0.25 level in fall-spawning populations had no effect on egg hatchability, it significantly increased the frequency of crippled fry by 37.6 percent and significantly decreased feed conversion efficiency (5.6 percent), fry survival to 147 days (14.6 percent), and growth rate to 147 days (6 percent) and 364 days (23.2 percent). Effects of inbreeding at F = 0.375 were more pronounced; significant differences included increased frequency of crippled fry (191.5 percent) and decreased feed conversion efficiency (14.9 percent), fry survival to 147 days (29.7 percent), and growth rate to 147 days (13.4 percent) and 364 days (33.5 percent). Application of the total effects of inbreeding on the number of fish remaining and the weight of fish remaining in a production lot at 1 yr of age indicated losses of 17.4 and 36.6 percent after one generation (F =

76-001307 CONTINUED
0.25) and 47.9 and 65.4 percent after two generations (F = 0.375) of brother-sister mating. Similar studies on a spring-spawning population produced similar results. General breeding methods that minimize the rate of inbreeding accumulation are discussed.

76-001308 MacKinnon, C. N.; Donaldson, E. M. ENVIRONMENTALLY INDUCED PRECOCIOUS SEXUAL DEVELOPMENT IN THE MALE PINK SALMON (/ONCORHYNCHUS GORBUSCHA/). J. Fish. Res. Board Can. 33 (11): 2602-2605. Nov. 1976. In English with French summ. SFA 21(4).
[Dep. Environ., Fish. Mar. Serv., Vancouver Lab., Vancouver, BC V6T 1X2, Canada] Nine males within a group of approximately 200 pink salmon (/Oncorhynchus gorbuscha/) reared in heated sea water became sexually mature in October of the year of hatching. These mature males (average weight = 119.44 g; average length = 19.8 cm) were larger than the immature males (average weight = 92.22 g; average length = 18.9 cm) but not significantly so. This is the first record of precocious development in pink salmon other than as a result of the use of exogenous gonadotropin.

WARMWATER CULTURE

76-001309 Allen, K. O.; Carter, R. R. POLYCULTURE OF CHANNEL CATFISH, TILAPIA, AND HYBRID BUFFALO IN DIVIDED RACEWAYS. Prog. Fish-Cult. 38 (4): 188-191. Oct. 1976. SFA 21(4).
[Environmental Effects Lab., Waterways Exp. Stn., Vicksburg, MS 39180] Two raceways 23 cm deep and two raceways 69 cm deep were each divided into four compartments designated C1, C2, C3, and C4. Water flowed through the compartments successively from C1 through C4. One raceway of each depth was stocked as follows: C1 and C4, channel catfish (/Ictalurus punctatus/); C2, tilapia (/Tilapia aurea/); and C3, bigmouth buffalo x black buffalo (/Ictiobus cyprinellus/ x /I. niger/). In the other two raceways, which served as controls, C1 and C4 were stocked with channel catfish and C2 and C3 contained no fish. The presence or absence of tilapia and buffalo in C2 and C3 had no effect on the survival and growth of catfish in the C4 compartments, nor was dissolved oxygen or total ammonia (NH(3)-N +NH(4)-H) affected. Depth of raceway had a positive effect on growth of catfish in the C4 compartments (/P/ less than 0.01), but did not affect dissolved oxygen or total ammonia. The net increase in weight of all fish was greater in the polyculture raceways (18.3 kg) than in the monoculture raceways (16.1 kg); total feed conversion was also better in the polyculture raceways (1.62) than in the controls (1.84). Both tilapia and buffalo ate a wide variety of microscopic plants and animals. Compartments in which tilapia were held were free of filamentous algae, whereas those with no fish had large amounts of filamentous algae and silt.

76-001310 Brcussard, M. C., Jr.; Simco, B. A. HIGH-DENSITY CULTURE OF CHANNEL CATFISH IN A RECIRCULATING SYSTEM. Prog. Fish-Cult. 35 (3): 138-141. July 1976. SFA 21(4)
[Dep. Wildl. Fish. Sci., Texas A&M Univ., College Station, TX 77843] An indoor recirculating system was designed to evaluate the effects of high flow rate and a high filter-to-tank ratio on the carrying capacity of recirculating systems for the culture of channel catfish (/Ictalurus punctatus/). A density of 213.2 kg/m^2 was obtained over a 194-day growing period, with greatest daily gains of 1.18 kg/m^3. Updraft and trickling filters containing various filter media were effective in reducing waste products. Production in this system was apparently limited at various times by dissolved oxygen, carbon

76-001310 CONTINUED
dioxide, and disease.

76-001311 Carter, R. R.; Allen, K. O. EFFECTS OF FLOW RATE AND AERATION ON SURVIVAL AND GROWTH OF CHANNEL CATFISH IN CIRCULAR TANKS. Prog. Fish-Cult. 38 (4): 204-206. Oct. 1976. SFA 21(4).
[U.S. FWS, Fish Farm. Exp. Stn., Stuttgart, AR 72160] Channel catfish (/Ictalurus punctatus/) at a density of 800 fish/m^3 were cultured in circular tanks at four combinations of flow rate and aeration, with two replications, each for 142 days. Two flow rates (8.4 and 14.7 min per exchange) were combined with either aeration or no aeration. Fish held at the "low flow-no aeration" condition ate significantly less food, had less efficient food conversion, and a slower growth rate than did fish held under the other three conditions (/P/ less than 0.01). There were no differences in survival or in total ammonia nitrogen levels. Fish held under the combinations of "low flow-aeration," "high flow-no aeration," and "high flow-aeration" yielded similar values for food consumption, conversion rates, and growth (all significantly better than those for fish reared with "low flow-no aeration"). Dissolved oxygen was less than 3 mg/l in the "low flow-no aeration" tanks on nine occasions, but only one value below 3 mg/l was recorded in water managed under the other three combinations. This experiment indicated that once sufficient water exchange or aeration was provided to ensure a minimum of about 3 mg/l of dissolved oxygen, increasing the dissolved oxygen concentration by increasing the flow or by aeration did not increase feed consumption or improve growth and food conversion.

76-001312 Rappaport, A.; Sarig, S.; Marek, M. RESULTS OF TESTS OF VARIOUS AERATION SYSTEMS ON THE OXYGEN REGIME IN THE GENOSAR EXPERIMENTAL PONDS AND GROWTH OF FISH THERE IN 1975. Bamidgeh 28 (3): 35-49. Sept. 1976. SFA 21(4).
[Minist. Agric., Fish. Dep., Genosar, Israel] Observations were carried out in 200 m^3 fishponds at the GENOSSAR Station with 5 different devices for the enrichment of pond water with oxygen. The observations were evaluated on the basis of percent oxygen saturation of the pond water just before sunrise. Measurements of oxygen saturation before sunrise have shown that installations which move pond water by pumping their lower layers and spraying them over the pond surface are more efficient than those which injected air into the pond water. The influence of low oxygen concentrations before sunrise on fish growth were evident only when saturation was below 25 percent (at water temperature of 20-25°C). The daily increment of carp per ha per day in the experimental ponds was 64-104 kg with a food conversion rate of 3.3-4.1. In intensive polyculture in farm ponds carp, tilapia and silver carp, the daily increment in weight per ha was 63-74 with a food conversion rate of 2.2-3.1. Under semi-intensive conditions, the increment per ha per day was 35-42 kg with a food conversion rate of 1.7-2.8. Increased stocking densities in intensive polyculture affected individual growth mainly that of carp and silver carp and much less so of tilapia.--From summ.

76-001313 Stanley, J. G. A REVIEW OF METHODS FOR OBTAINING MONOSEX FISH AND PROGRESS REPORT ON PRODUCTION OF MONOSEX WHITE AMUR. J. Aquatic Plant Manage. 14: 68-73. June 1976. SFA 21(4)
[Maine Coop. Fish. Res. Unit, Univ. Me., Orono 04473]

76-001314 Tamas, G.; Horvath, L. GROWTH OF CYPRINIDS UNDER OPTIMAL ZOOPLANKTON CONDITIONS. Bamidgeh 28 (3): 50-56. Sept. 1976. SFA 21(4).

[Warm Water Fish Hatchery, Szazhalombatta, Hungary] In the routinely prepared ponds, Copepods and large-bodied Cladocera species compete with Rotatoria. Therefore, one can not wait until after flooding for these groups to multiply and the fry must be stocked within a few days of flooding. Moreover, Copepods are also deleterious for the very delicate, several millimeter-sized fish larvae. If stocking is carried out within this period, the number of fry introduced should be low because the amount of available zooplankton in the flooding water is also low. Cladocera and Copepods can be eliminated from the ponds by treatment with organophosphate pesticides, thus enabling Rotatoria plankton to multiply. The ponds' rich stock of Rotatoria ensure ideal starting feed for the fish. At the concentrations applied, the chemicals do not interfere with the physiological functions of the fish. The phosphates break down in the water within a few days and so there is opportunity for repopulation of the Crustacea, the latter by this time having become a necessary and important feedstuff. By appropriate chemical treatment, Copepods can be eliminated from the ponds allowing the Rotatoria to develop. Consequently, the number of fry per surface unit and their survival might be increased.--Summ.

76-001315 Titarev, Ye. F. ACCELERATION OF MATURATION IN THE RAINBOW TROUT (/SALMO GAIRDNERI/) UNDER THE INFLUENCE OF INCREASED WATER TEMPERATURE. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol., 15 (3): 507-509. 1975. SFA 21(4)

[VNIIPRKh, Rybnoye Settlement, Moscow, USSR] The use of warm industrial waste waters makes it possible to reduce the time at which trout spawners mature to an age of 1 year instead of 2+ and 3+ in natural waters in the central zone of the USSR. The earlier maturation of the trout in a cooling pond creates the prerequisites for the organization of a complete trout farming system in which the time taken to produce saleable output is reduced to a minimum (less than 1 year).--From concl.

MARICULTURE

76-001316 Barkmann, R. C.; Beck, A. D. INCUBATING EGGS OF THE ATLANTIC SILVERSIDE ON NYLON SCREEN. Prog. Fish-Cult. 38 (3): 148-150. July 1976. SFA 21(4)

[Biol. Dep. Springfield Coll., Springfield, MA 01109] Eggs of the Atlantic silverside (/Menidia menidia/) were separated and incubated on nylon screen; mean hatching success ranged from 53.7 to 83.3 percent, compared with 4.7 percent for eggs incubated in clumps. The technique was satisfactory under both static and continuous-flow conditions. Combination of the screen technique with a flow-through culture vessel provides a method for rearing large numbers of /M. menidia/ eggs and larvae that is effective and easy to maintain.

76-001317 Kock, K.-H. UEBER DIE HALTUNG VON DORSCHEN (/GADUS MORHUA/ L.) IN NETZKAEFIGEN. [KEEPING OF COD (/GADUS MORHUA/ L.) IN NET CAGES.] Arch. Fischereiwiss. 26 (1): 35-48. Aug. 1975. SFA 21(4)

[Inst. Kusten- Binnenfisch. Bundesforschungsanst. Fisch., Hamburg, West Germany] In 19 experiments 945 tagged and 1024 untagged cod (/Gadus morhua/ L.) of the Western Baltic were kept over different periods (3 hours-108 days) in net cages. The fish were caught by otter trawl, set nets and eel traps. The following aspects are considered to be important for keeping cod in net cages:

1. Cod should be caught in autumn or winter when they are less vulnerable against fishing gear. Transport losses and diseases are then reduced to a minimum.

2. Cod have an optimum increase in length and weight when feeding on pieces of herring two times a week. When feeding with herring one must take into consideration that herring is often host of several diseases i.e. /Ichthyosporidium hoferi/ (Fungi).

3. From January to May (spawning time) one can expect that cod don't grow because they reduce or stop feeding. It seems that great physiological stress in the spawning time supports the occurrence of diseases like bacterial tail rot.

4. To avoid losses by unfavourable hydrographical conditions in summer, one must keep cod in waters below 15° C. When temperature rises above 19° C cod stop feeding. Temperatures of more than 19° C induce high losses among the fish.

FEEDS, FEEDING AND NUTRITION

76-001318 Fowler, L. G.; Banks, J. L. ANIMAL AND VEGETABLE SUBSTITUTES FOR FISH MEAL IN THE ABERNATHY DIET, 1973. Prog. Fish-Cult. 38 (3): 123-126. July 1976. SFA 21(4)

[U.S. FWS, Abernathy Salmon Cult. Develop. Cent., Longview, WA 98632] In a 20-week feeding trial with fall chinook salmon (/Oncorhynchus tshawytscha/), fish meal in the Abernathy diet formula was partly replaced with substitute sources of protein. Cottonseed meal and spray-dried blood meal proved to be satisfactory partial replacements and did not affect growth if fish meal was maintained at a level of 25-30 percent of the diet. Growth of fish was inhibited, however, when soybean grits or meat-and-bone meal was used as a fish meal substitute. Peruvian anchovy meal proved to be as satisfactory as herring meal when fed alone, and the growth of fish increased when two meals were used in combination.

76-001319 Fowler, L. G.; Banks, J. L. FISH MEAL AND WHEAT GERM MEAL SUBSTITUTES IN THE ABERNATHY DIET, 1974. Prog. Fish-Cult. 38 (3): 127-130. July 1976. SFA 21(4)

[U.S. FWS, Abernathy Salmon Cult. Develop. Cent., Longview, WA 98632] Feeding trials were conducted with fall chinook salmon (/Oncorhynchus tshawytscha/) to determine if a lowered protein diet would affect growth and to find replacements for herring and wheat germ meals in the Abernathy diet. A diet containing 45 percent crude protein produced larger fish than did a diet with 42 percent protein, but the increased growth occurred primarily during the first portion of the feeding trial when the fish were small. Shrimp meal fed at a 5 percent level of the diet produced increased growth when used as a partial replacement for herring meal, but when shrimp meal made up 20 percent of the diet, less growth occurred than in fish on the control diet. Neither menhaden meal nor tuna scrap meal, used as total or parital replacement for herring meal, was satisfactory. Brewers dried

76-001319 CONTINUED
grains and shrimp meal were both successful wheat germ substitutes, but corn fermentation solubles were not.

76-001320 Koops, H.; Tiews, K.; Beck, H.; Gropp, J. DIE VERWERTUNG VON SOJAPROTEIN DURCH DIE REGENBOGENFORELLE (/SALMO GARIDNERI/). [THE UTILIZATION OF SOYBEAN PROTEIN BY THE RAINBOW TROUT (/SALMO GAIRDNERI/).] Arch. Fischereiwiss. 26 (2/3): 181-191. Feb. 1976. In German with English summ. SFA 21(4)

[Inst. Kusten- Binnenfisch. Bundesforschungsanst. Fisch., Hamburg, West Germany] Using isocaloric feed rations having had crude protein levels of 47 percent and 39 percent, it could be demonstrated that heavy growth depressions occur in rainbow trout, if fishmeal is entirely replaced by soybean protein applied as soybean fine meal or isolated soybean protein (Purina). When applying equal quantities of food the feed conversion was with 2.5-3.0 roughly double as high as in the fish meal rations having had a feed conversion between 1.3-1.4, the weight gain less than half. Adding of amino acids did not influence the feed conversion. Furthermore the trout rejected greatly the soybean rations because of taste. This could be compensated only partially when soybean oil was replaced by red fish oil. It could be demonstrated, however, that the rainbow trout can nevertheless utilize soybean protein (supplemented by methionine) as well as animal protein, when a second experiment 25 percent of the fishmeal protein was replaced by the soybean concentrate "Haypro". In this case feed conversion and growth rate were as favourable as in the control ration. Adding of amylolytic enzymes to the Haypro-ration did not yield any improvement of the result.

76-001321 Koops, H.; Mann, H. MORPHOMETRISCHE MESSUNGEN AN REGENBOGENFORELLEN UNTER VERSCHIEDENEN HALTUNGSBEDINGUNGEN. [MORPHOMETRIC MEASURES OF RAINBOWTROUTS CULTURED UNDER DIFFERENT CONDITIONS.] Arch. Fischereiwiss. 26 (3): 99-102. Apr. 1975. In German with English summ. SFA 21(4)

[Inst. Kusten-Binnenfisch. Bundesforschungsanst. Fisch., Hamburg, West Germany] Measurements of the proportions were made on the bodies of trouts cultered under different conditions. One group (1) was fed with chopped fishes, another on (2) with pellets. These fishes had grown up in ponds. A third group (3) had been fed in cages with pellets. The specimens of the first group were more slender and had smaller fins than those of the second group. The best values were obtained in group 3 (greatest thickness, high dorsum, small head, small paired fins).

76-001322 Main, J. K.; van Driel, A. E.; Chiszar, D. A.; Windell, J. T. EFFECTS OF A COMMERCIAL APPETITE STIMULANT ON FEEDING BEHAVIOR OF BLUEGILLS. Prog. Fish-Cult. 38 (4): 211-212. Oct. 1976. SFA 21(4).

[Lab. Anim. Physiol. Behavior, Univ. Colo., Boulder 80309] Twelve recently captured bluegills (/Lepomis macrochirus/) were individually maintained in 28.5-liter compartments of 57-liter aquariums. The water in the compartments of six fish was treated with a cobalamin-containing commercial appetite stimulant at the recommended dosage. The six fish in the other compartments served as controls. Each fish was offered herring-meal pellets daily and records were kept of the number of pellets consumed and of the number of feeding responses involved in the ingestion of the pellets. During the first 7 days the two groups did not differ significantly by either measure. During days 8 through 14, however, the control group ate significantly fewer pellets (average, 3.6) than the experimental group (average, 5.9), and the feeding behavior of the control group was significantly "less efficient" than that of the experimental group.

76-001323 Mironova, N. V. THE NUTRITIVE VALUE OF ALGAE AS FOOD FOR /TILAPIA MOSSAMBICA/. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 510-514. 1975. SFA 21(4)
[Zool. Inst., Acad. Sci., Leningrad, USSR]

76-001324 Ostroumova, I. N.; Shabalina, A. A.; Timoshina, L. A.; Knyazeva, L. M.; Sherstneva, T. A.; Pozdnyak, I. S.; Rozhdestvenskaya, Y. N. THE COMPOSITION OF DRY PELLET FEEDS AND THEIR EFFECT ON THE PHYSIOLOGICAL AND BIOCHEMICAL CHARACTERISTICS OF YEARLING RAINBOW TROUT (/SALMO GAIRDNERI/). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 486-494. 1975. SFA 21(4)
[GosNIORKh, Leningrad, USSR] An examination is made of the use of the first Soviet-produced dry pellet feeds for the rainbow trout (/Salmo gairdneri/), made up in accordance with the GosNIORKh 1972 recipe balanced for amino acids, the energy-protein ratio and vitamins. The excellent productive properties and biological value of the pellets has been established in the feeding of rainbow trout yearlings. The peroxide and acid numbers were increased following prolonged storage. This gave rise to fatty degeneration of the liver and anemia in the trout, and a reduction in growth rate and lower conversion values. Deviations from the physiological norm when pellets (not containing antioxidants) are fed usually begin within 2.5-3 months. In this connection the storage life of dry pellet food for trout (the GosNIORKh 1972 recipe) must not exceed 2 months.

76-001325 Schalles, J. F.; Wissing, T. E. EFFECTS OF DRY PELLET DIETS ON THE METABOLIC RATES OF BLUEGILL (/LEPOMIS MACROCHIRUS/). J. Fish. Res. Board Can. 33 (11): 2443-2449. Nov. 1976. In English with French summ. SFA 21(4).
[Dep. Biol., Emory Univ., Atlanta, GA 30322] Experiments were designed to evaluate the effects of five dry pellet diets containing various protein levels on metabolic rates and energy cost of food utilization of bluegill (/Lepomis macrochirus/). In the 48-h period after feeding metabolic rates increased an average of 57 percent above base levels established prior to food presentation. The energy cost of food utilization, estimated as a percentage of ingested food energy, was approximately bar x 14.90±0.96 percent SE (range 7.5-32.3 percent). Positive correlation was found between protein and caloric intakes and the increases in O(2) consumption observed after feeding. Percent protein in the diet had no significant effect on mean values of O(2) consumption after feeding or the estimates of the energy cost of food utilization. Probably the calorigenic effect of protein in fishes, which are principally ammonotelic, is considerably lower than that observed in ureotelic and uricotelic vertebrates. The mean estimate (14.90 percent of ingested energy) for the bluegill could reflect a low specific dynamic action of protein in conjunction with the calorigenic effect of the carbohydrate and lipid components of the diets.

76-001326 Spataru, P. NATURAL FEED OF /TILAPIA AUREA/ STEINDACHNER IN POLYCULTURE, WITH SUPPLEMENTARY FEED AND INTENSIVE MANURING. Bamidgeh 28 (3): 57-63. Sept. 1976. SFA 21(4).
[Fish Aqua-Cult. Res. Stn., Dor, Israel] This paper deals with certain aspects of /T. aurea/ feed when growth under conditions of polyculture in ponds whose feed had been supplemented with sorghum and manure. From an analysis of the intestinal contents of /T. aurea/, it may be concluded that the feed supplement introduced into the ponds had to pass through the benthos elements (Oligochaeta, Chironomidae,

76-001326 CONTINUED
Ostracoda and detritus) in order to be utilized. Analyses of feed components of fish in ponds type 1 and 2 (sorghum and manure supplemented, respectively), compared with those of ponds type 3 and 4 (manure only) as well as analyses of plankton and benthos samples, have led to the conclusion that the first two types of ponds are superior with respect to quantity of natural feed and enhance weight increase of the fish. A quantitative analysis of the feed elements, has shown that /T. aurea/ in our studies, utilizes zooplankton and zoobenthos to an insufficient extent.--From concl.

76-001327 Tiews, K.; Gropp, J.; Koops, H. ON THE DEVELOPMENT OF OPTIMAL RAINBOW TROUT PELLET FEEDS. Arch. Fischereiwiss. In English and German. SFA 21(4)
[Inst. Kuster-Binnenfisch. Bunderforschungsanst. Fisch., Hamburg 50, Palmaille 9, West Germany]

76-001328 Twongo, T. K. DEVELOPMENT OF FEEDING IN THE HATCHERY RAINBOW TROUT (/SALMO GAIRDNERI/ RICHARDSON). Ph. D. dissertation, Univ. Guelph 1976. From Diss. Abstr. Int. B Sci. Eng. 37(3), 1976. SFA 21(4)
The research consisted of three components: 1. A study of the histogenesis of the oropharyngeal region of the alimentary tract of the rainbow trout /Salmo gairdneri/ Richardson. 2. An investigation of the development of feeding behaviour of the eleutheroembryos and alevins. 3. A determination of the influence of the age at initial food presentation on alevin food intake survival and subsequent growth. Integrated, the three components were aimed at providing information on the development of feeding in rainbow trout, and hopefully, on the causes of non-feeding and alevin mortality in hatcheries at the stage of transition to exogenous feeding. Analysis of feeding behaviour data indicated that the most favorable time to initiate feeding young rainbow trout was at 35 days (9C) when the yolk reserve was depleted and they were most responsive to food. The inference was corroborated by information from food deprivation experiments, which showed that the group of alevins first fed on day 35 (two weeks later than the age at swim-up) had the most uniform size fish, with the highest mean weight and length at the end of the experimental period. From these experiments, it was also concluded that withholding of food from young rainbow trout for some time after swim-up does not impair their ability to learn to feed. The relationships between the development of the oropharyngeal mucosa and the development of feeding are discussed, as well as the anatomical and behavioural features noted in this study that are likely to contribute to non-feeding and stunting in hatcheries.--From abstr.

MISCELLANEOUS CULTURE TECHNIQUES AND EQUIPMENT

76-001329 Dushkina, L. A. VIABILITY OF HERRING (/CLUPEA/) EGGS AND FERTILIZING CAPACITY OF HERRING SPERM STORED UNDER VARIOUS CONDITIONS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 423-429. 1975. SFA 21(4)
[PINRO, Murmansk, USSR] The methods of storing the sexual products of the herring available for use under field conditions are examined. The period for which the gametes of the herring retain the capacity to take part in the process of fertilization when kept in various media was longer than the time within which they lost the properties ensuring the subsequent normal development of the fertilized eggs. Different methods are proposed for the delivery of the sexual products

76-001329 CONTINUED
of females and males from the fishing grounds tc experimental bases.

76-001330 Huner, J. V.; Avault, J. W., Jr. SEQUENTIAL POND FLOODING: A PROSPECTIVE MANAGEMENT TECHNIQUE FCR EXTENDED PRODUCTION OF BAIT-SIZE CRAWFISH. Trans. Am. Fish. Soc. 105 (5): 637-642. Sept. 1976. SFA 21(4).
[Dep. Biol. Sci., Southern Univ., Baton Rouge, LA 70813] Twelve 0.005-hectare earthen ponds with established crawfish populations [/Procambarus clarkii/ (Girard)] were drained in June 1973 and four each were flooded on 1 September, 1 October, and 1 November 1973. Substantial numbers of bait-size (5.0-7.0 cm tctal length) crawfish were available from early October through May 1974 when ponds were drained. Population dynamics differed considerably from previously reported studies and are discussed. Trapping was selective for nonmolting crawfish and is the recommended harvesting technique if crawfish are to be held for over 1-2 days.

76-001331 Jones, B. C.; Geen, G. H. FORCE-FEEDER FOR LARGE FISHES. Prog. Fish-Cult. 38 (4): 213. Oct. 1976. SFA 21(4).
[Dep. Biol. Sci., Simon Frazer Univ., Burnaby, BC V5A 1S6, Canada] Using the multiposition force-feeder described, one person can quickly and easily feed specific quantities of experimental diets to large fish held in captivity.

76-001332 Martini, F. H. EFFECTS OF CAPTURE AND FASTING CONFINEMENT ON AN ELASMOBRANCH, /SQUALUS ACANTHIAS/. Ph.D. dissertation, Cornell Univ. 114p. 1974. From Diss. Abstr. Int. B Sci. Eng. 35(7), 1975. SFA 21(4).
/Squalus acanthias/ were placed in live cars to assess the effects of confinement and starvation cn this species. Four experimental groups were used and blood and tissue samples taken at intervals throughout a period of confinement of up to 23 days. These were compared with samples from freshly-caught animals and animals left undisturbed in the experimental pens. Physiological alterations took place immediately on introduction of the sharks to the experimental pens. Weight loss over the period of starvation averaged 13.6 percent. Atrophy of skeletal muscle was apparent in the starved animals. No obvious changes were observed in the tissue of the endocrine pancreas; the exocrine pancreas displayed marked deterioration. No consistant alterations were observed in the epithelium of the digestive tract. Behavioral changes involved a gradual decrease in spontaneous swimming. A loss of equilibrium was followed by immobility and death within three and a half weeks after introducticn to the experimental enclosure. Alterations induced by fasting confinement are of sufficient magnitude to demand more rigorous criteria for the selection of experimental subjects. Recommendations for the capture, care, maintenance, and selection of elasmobranchs are presented for use in future experimental investigations. --From abstr.

76-001333 Nagel, T. TECHNIQUE FOR COLLECTING NEWLY HATCHED FATHEAD MINNOW FRY. Prog. Fish-Cult. 38 (3): 137. July 1976. SFA 21(4)
[Ohio Dep. Nat. Resour., London Fish Hatchery, London, OH 43143] Muskellunge (/Esox masquinongy/) being reared in an intensive culture must receive the appropriate size of forage to exist. Newly hatched fathead minnows (/Pimephales promelas/) are of the correct size and hatch at about the desired time to be used as forage by the swim-up muskellunge fry. Minnow eggs which exhibit embryos with a golden iris, collected from black polyethylene sheeting, usually hatch within 1 h after being removed from the pond.

76-001334 Nelson, S. G.; Andersen, A. C.; Momeni, M. H.; Yeo, R. R. ATTEMPTED STERILIZATION OF SEXUALLY UNDIFFERENTIATED FRY OF /TILAPIA ZILLII/ BY ^{60}COBALT GAMMA-RAY IRRADIATION. Prog. Fish-Cult. 38 (3): 131-134. July 1976. SFA 21(4)

[Dep. Land Air Water Resour., Univ. Calif., Davis 95616] Fry of /Tilapia zillii/ from a single spawn were continuously exposed to ^{60}Cobalt Gamma-ray irradiation during the period of sexual differentiation. Groups of 9 to 21 fry were exposed to dosages ranging from 0 to 4.0 R/h for 35 days to obtain total dosages as high as 3,300 R. Histological examination of the gonads reveled no demonstrable radiation effects.

76-001335 Svensson, K. M. ROTATOR FOR PROTECTING CIRCULAR FISH PONDS AGAINST PREDATORY BIRDS. Prog. Fish-Cult. 38 (3): 152-154. July 1976. SFA 21(4)

[Salmon Res. Inst., Alvkarleby, Sweden S-810 70] A Rotator driven by gravity flow of water prevents birds from taking fish in outdoor circular ponds. When placed over each pond and operated at a speed of 20 rpm, the rotator prevents gulls, terns, and other birds from entering the ponds to catch fish. A short axle fastened vertically at the end of the bridge at the center of the pond disperses water to 8 nozzles on the rotator. If desired, the rotator can easily be removed as it rests untied on the axle. Experience from three summers of continuous use shows no negative effect on fish. The protector, because of its simplicity, has several advantages over most other devices used against bird predation in ponds: it is inexpensive to install and maintain, it can easily be removed when fish in the ponds are to be weighed or removed, and it has a superior aesthetic appearance.

76-001336 Theis, G. L.; Sears, F. W. MODIFIED "MORTON" FISH GRADER. Prog. Fish-Cult. 38 (4): 202-203. Oct. 1976. SFA 21(4).

[U.S. FWS, Lamar Fish Cult. Develop. Cent., Lamar, PA 16848] Modifications were made to a "Morton" grader so that it could be used with a hydraulic fish pump. The modifications include an added dewatering hopper to separate the fish from the excess water delivered by the fish pump, changes to the spray system so that the grader bars are lubricated by the excess water, and added fish hoppers to that each size may be collected and returned to the raceway. The grader operates on a pickup truck and eliminates manual lifting of the fish.

GENERAL LIMNOLOGY AND OCEANOGRAPHY

76-001337 Anderson, R. S.; Green, R. B. LIMNOLOGICAL AND PLANKTONIC STUDIES IN THE WATERTON LAKES, ALBERTA. Can. Wildl. Serv. Occas. Pap. No. 27: 41p. 1976. In English with French summ. SFA 21(4).

Limnological studies were conducted in the main lake system in Waterton Lakes National Park from 1969 to 1975 to provide baseline data for management purposes. During 1972-75, 19 crustacean and 12 rotiferan species of zooplankton and a total of 164 species and subspecies of phytoplankton were identified from the three main lakes. Comparison with earlier studies and samples indicated little change in zooplankton species composition, although numbers appeared to have increased. Changes in species composition and increases in abundance have occurred in the phytoplankton. During the study period, water temperatures, light penetration, water renewal rates, and most

76-001337 CONTINUED
chemical parameters have remained fairly constant. Although enrichment by sewage may have been responsible for increases in plankton abundance, chemical and biological indicators suggest that the oligotrophic status of the lakes has not been impaired. Longitudinal circulation in Upper Waterton Lake probably contributed to a greater retention of nutrients in that lake in 1972 and 1973 than in 1974 and 1975. The effects of enrichment on the phytoplankton in the downstream lakes appeared to be greater in the latter two years. A monitoring program using at least four stations along the main lake system and involving sampling at two discrete depths, one in the upper 5 m and the other below the thermocline, would be more useful for total lake assessment than more detailed effort at one or two stations.

76-001338 Campbell, N. J. AN HISTORICAL SKETCH OF PHYSICAL OCEANOGRAPHY IN CANADA. J. Fish. Res. Board Can. 33 (10): 2155-2167. Oct. 1976. In English with French summ. SFA 21(4)
[Dep. Environ., Fish. Mar. Serv., Ottawa, ON K1A 0E4, Canada] The history of Canadian oceanography is outlined through the contribution of individual scientists and the organization or programs they were associated with from 1890 to the early 1970s. The period up to 1960 reflects not only the scientific and personal efforts of H. B. Hachey, J. P. Tully, W. M. Cameron, and G. L. Pickard, but also their work in establishing oceanography as a science in Canada. The organizational developments which took place in the 1960s and their culmination in the building of the Bedford Institute of Oceanography, the Canada Centre for Inland Waters, and the Institute of Ocean Sciences now under construction on the west coast are described.

76-001339 Huntsinger, K. R.; Maslin, P. E. A LIMNOLOGICAL COMPARISON OF THE THREE BASINS OF EAGLE LAKE, CALIFORNIA. Calif. Fish Game 62 (4): 232-245. Oct. 1976. SFA 21(4).
[Dep. Geol. Phys. Sci., Calif. State Univ., Chico 95929] A comparison of the limnological characteristics of the three basins of Eagle Lake, California was conducted during 1971-72. Light extinction, dissolved oxygen, electrical conductivity, chlorophyll /a/ concentration, primary productivity, and plankton were investigated in each basin. On the basis of morphometry, the north and central basins were expected to be more eutrophic than the south basin. They are shallow, do not stratify, and have smooth, regular shorelines. However, the deeper south basin was less clear, more productive, and had greater populations of plankton. The discrepancy between expected and observed trophic state can best be explained by the additional availability of nutrients in the south basin.

76-001340 Schindler, D. W.; Newbury, R. W.; Beaty, K. G.; Campbell, P. NATURAL WATER AND CHEMICAL BUDGETS FOR A SMALL PRECAMBRIAN LAKE BASIN IN CENTRAL CANADA. J. Fish. Res. Board Can. 33 (11): 2526-2543. Nov. 1976. In English with French summ. SFA 21(4).
[Dep. Environ., Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB R3T 2N6, Canada] Results of a 4-yr study of the hydrology of the Rawson Lake watershed, as well as the chemistry of precipitation, streamflow, and the lake are presented. Inputs of water and most chemicals varied by as much as 2 times from one year to the next, illustrating that several years' data are necessary to determine accurately average nutrient inputs and losses from an ecosystem. Precipitation appeared to be almost the sole source of P and N to lake and terrestrial ecosystems, although N(2) fixation cannot be dismissed in the latter case. Significant proportions of Ca, Mg, Na, K, Cl, and SO(4) were supplied directly from precipitation. The lake also received substantial quantities of these elements as well as silicon, from

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weathering of terrestrial geological materials. Although far from any major industrial sources of SO(2), the pH of precipitation averaged less than 5 for the years studied. Both terrestrial and lake systems retained a high proportion of entering P and N, and smaller proportions of other nutrients. Interpretation of relative retentions of nutrients revealed that the terrestrial ecosystem has well-balanced P and N supplies, while the lake was P limited. Rates of loss of chemicals from the terrestrial watershed of Rawson Lake are comparable to other sites in the Precambrian Shield, but lower than values from other geological settings.

76-001341 Unesco MARINE SCIENCES IN THE GULF AREA. Unesco Tech. Pap. Mar. Sci. 26. 66p. 1976. SFA 21(4).
[Place de Fonterey, 75700-Paris, France]

76-001342 Unesco SEVENTH REPORT OF THE JOINT PANEL ON OCEANOGRAPHIC TABLES AND STANDARDS. Unesco Tech. Pap. Mar. Sci. 24. 61p. 1976. SFA 21(4).
[Place de Fonteroy, 75700-Paris, France]

PHYSICAL LIMNOLOGY AND OCEANOGRAPHY

76-001343 Thomas, R. L.; Jaquet, J.-M.; Kemp, A. L. W.; Lewis, C. F. M. SURFICIAL SEDIMENTS OF LAKE ERIE. J. Fish. Res. Board Can. 33 (3): 385-403. Mar. 1976. In English with French summ. SFA 21(4).
[Canada Cent. Inland Waters, Burlington, ON L7R 4A6, Canada]

CHEMICAL LIMNOLOGY AND OCEANOGRAPHY

76-001344 Wilen, B. O. SOURCES OF ORGANIC COLOR IN NATURAL WATERS. Ph. D. dissertation, Univ. Mass. 358p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(4), 1976. SFA 21(4)
The organic matter research was conducted in Western Massachusetts on a 3,000 acre watershed containing a complex of three interconnected reservoirs with a combined capacity of 46,000,000 gallons and a safe yield of 1.1 million gallons a day. Initial research efforts pinpointed the sources of organic-coloring-matter production as the wetlands in the headwaters of the watershed. Although water color production depends on climate, vegetation, land-surface form, and soils, research indicates that climate and the land-surface form of the local setting are the most important variables in water color production. A water color prediction model was developed which presented a functional tool to watershed managers for predicting water color levels at the source of production. The model's success was due to the fact that the level of water color produced is very similar for different wetland types at the source of production.--From abstr.

BENTHOS

76-001345 Cooper, C. M. DYNAMICS OF BENTHIC FAUNA OF GRENADA RESERVOIR, MISSISSIPPI. Ph. D. dissertation, Univ. Miss. 161p. 1976. From Diss. Abstr. Int. B Sci. Eng 37(3), 1976. SFA 21(4)

The macrobenthos of Grenada Reservoir, Mississippi, was studied for 26 months during the period from February, 1973, through August, 1975. A total of 39 genera and 41 species of animals was collected. Biomass production during the study fluctuated because of environmental factors brought about by unusually high water but was found to be average or better in comparison to other southern flood control reservoirs. A discussion of the replacement of the /Hexagenia/- /Oecetis/- Tendipendidae community in the conservation pool by a /Chaoborus/- Tendipendidae community because of environmental changes is also presented. The community degradation due to environmental stress in a restricted area of the reservoir and its probable indication of organic pollution is discussed. Life cycles, emergences, and associated phenomena of insects are discussed as is the subject of drawdown and how it affects benthos. The possible use of insects as indicators of environmental stress and pollution is discussed as are the contributions of tributaries to reservoir benthos.--From abstr.

76-001346 Gilpin, B. R.; Brusven, M. A. SUBSURFACE SAMPLER FOR DETERMINING VERTICAL DISTRIBUTION OF STREAM-BED BENTHOS. Prog. Fish-Cult. 38 (4): 192-194. Oct. 1976. SFA 21(4).

[Dep. Biol., Moscow High School, Moscow, ID 83843] A subsurface benthic canister sampler was developed and tested as a method for determining vertical distribution of insects in the upper 30 cm of a stream bed. The sampler is a cylinder, 13.9 cm wide and 30.4 cm high, made of perforated, 16-gauge steel. The advantages of the canister sampler are: (1) it is easy to construct; (2) the time required for removal from stream bed and emptying its contents is short, thus preventing major shifts in benthic organisms; (3) the surface area and volume are large enough to provide for satisfactory sampling of subsurface benthos; (4) implantation of the canister causes no major disturbance to the surrounding stream bed; and (5) the vertical distribution of sediments and macrobenthos can be evaluated both quantitatively and qualitatively.

76-001347 Gray, R. H.; Neitzel, D. A. SURBER SAMPLING IN DEEP WATER FOR BOTTOM ORGANISMS. Prog. Fish-Cult. 38 (3): 142-143. July 1976. SFA 21(4)

[Battelle Pacific Northwest Lab., Richland, WA 99352] A modified Surber sampler used by SCUBA divers in deep waters of large rivers, consists of a thick-walled canvas bag wired inside the lower quarter of a fine mesh collecting net. Divers stabilize themselves on the bottom by clinging to rocks or with an anchor, position the sampler, and carefully place gravel and rocks in the canvas bag. Dislodged organisms are carried by the current into the canvas bag and collecting net. The method has application where current velocity and bottom composition make other methods of quantitave benthic sampling either impractical or prohibitively expensive and time-consuming.

76-001348 McCullough, J. D.; Williams, S. ELECTRICALLY POWERED SAMPLER FOR BENTHIC MACROINVERTEBRATES. Prog. Fish-Cult. 38 (4): 186-187. Oct. 1976. SFA 21(4).
[Dep. Biol., Stephen F. Austin State Univ., Nacogdoches, TX 75961] The lightweight, 516.2 cm^2 grab sampler described, which is powered by a reversible motor and operated by a hand-held control unit, is very efficient in sand, silt, clay and gravel bottoms. It supplies enough power to break small branches and roots.

76-001349 Swiss, J. J.; Johnson, M. G. ENERGY DYNAMICS OF TWO BENTHIC CRUSTACEANS IN RELATION TO DIET. J. Fish. Res. Board Can. 33 (11): 2544-2550. Nov. 1976. In English with French summ. SFA 21(4).
[Dep. Environ., Environ. Prot. Serv., Halifax, NS B3J 1M5, Canada] Energy dynamics were studied in /Asellus racovitzai/ (Crustacea: Isopoda) and /Gammarus fasciatus/ (Crustacea: Amphipoda) fed various selected algal species and lake sediments. Calculations of growth, production, assimilation, and growth efficiency were made from measurements of weight change, respiration rate, and caloric content of experimental animals. Although growth rate, production, and growth efficiency were often highest in animals fed green algae, differences were not attributable solely to green vs. blue-green taxonomic groups. The relationship between assimilation rate and growth efficiency was examined, and the possible consequences of lower values of assimilation were discussed in terms of delayed development to maturity and reproduction. --From abstr.

PLANKTON

76-001350 Herrgesell, P. L. CRUSTACEAN ZOOPLANKTON BIOMASS AND ITS RELATIONSHIP TO VARYING LEVELS OF EUTROPHY IN LAKE BERRYESSA, CALIFORNIA. Ph. D. dissertation, Univ. Calif. (Davis) 302p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(3), 1976. SFA 21(4)
The relationship between crustacean zooplankton biomass and varying levels of eutrophy in a mesotrophic reservoir was investigated in Lake Berryessa, Napa County, California. Analysis of zooplankton biomass data suggested that there is a density-dependent process operating with regard to zooplankton standing crop and trophic status. More eutrophic areas in Lake Berryessa supported greater standing crops (biomass) of zooplankton.--From abstr.

76-001351 Stewart, A. J.; Blinn, D. W. STUDIES ON LAKE POWELL, USA: ENVIRONMENTAL FACTORS INFLUENCING PHYTOPLANKTON SUCCESS IN A HIGH DESERT WARM MONOMICTIC LAKE. Arch. Hydrobiol. 78 (2): 139-164. Aug. 1976. SFA 21(4)
[Dep. Biol. Sci., North. Ariz. Univ., Flagstaff 86001] Limnological studies were conducted on lower Lake Powell, a large desert reservoir in southwestern USA. Three stations were selected along a horizontal transect in Warm Creek Bay to determine the physical, chemical and biological differences based on depth and proximity to terrestrial influence. The bay was found to be a warm monomictic system that initiated overturn in mid-October to early November, depending upon the depth of the sampling station. Restratification started about the end of April. Summer thermal stratification led to a zone of oxygen depletion below 15 meters at the two deepest stations. The shallowest station (5m) did not stratify in this manner resulting in different physico-chemical and biological conditions. The twenty dominant algal species consistently made up 85 percent or more of the total number of cells at any given sampling date and maximal algal populations were

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typically subsurface. The pattern of seasonal algal succession was typical of that found in many moderate-sized temperate lakes--a spring diatom pulse, a diverse phytoplankton summer community, a late autumn diatom increase and a pronounced winter phytoplankton paucity. Correlation coefficients were calculated between total algal density, certain dominant species and various environmental parameters which implicated water temperature as an extremely important regulator of phytoplankton density. Concentrations of nitrogen compounds often correlated significantly with total number of phytoplankton cells and individual species. Evidence is presented to support the beliefs that diatoms may be less valid indicator organisms than other phytoplankton groups.--From abstr.

PRIMARY PRODUCTION

76-001352 Huntsinger, K. R.; Maslin, P. E. CONTRIBUTION OF PHYTOPLANKTON, PERIPHYTON, AND MACROPHYTES TO PRIMARY PRODUCTION IN EAGLE LAKE, CALIFORNIA. Calif. Fish Game 62 (3): 187-194. July 1976. SFA 21(4).
[Dep. Geol. Phy. Sci., Calif. State Univ., Chico 95929] The importance of phytoplankton, periphyton, and macrophytes to primary production in each of the three basins of Eagle Lake, California was considered. Phytoplankton and periphyton production were measured using the oxygen light and dark bottle method. Production by macrophytes was determined by harvesting at maximum biomass. Although phytoplankton accounts for 89 percent of the annual carbon fixed in the south basin of Eagle Lake, periphyton and macrophytes contribute as much as one third of the primary production in the shallower north and central basins.

MORPHOLOGY

76-001353 Gee, J. H. BUOYANCY AND AERIAL RESPIRATION: FACTORS INFLUENCING THE EVOLUTION OF REDUCED SWIM-BLADDER VOLUME OF SOME CENTRAL AMERICAN CATFISHES (TRICHOMYCTERIDAE, CALLICHTHYIDAE, LORICARIIDAE, ASTROBLEPIDAE). Can. J. Zool. 54 (7): 1030-1037. July 1976. In English with French summ. SFA 21(4)
[Dep. Zool., Univ. Manitoba, Winnipeg, MB R3T 2N2, Canada] Swim-bladder volume of nine species of Central American catfishes from four families was measured and found to be very small. In seven species it supported less than 5 percent of the body weight in water. Seven of the nine species were found to breathe air and the volume of gas in the accessory respiratory organ varied between species, supporting from less than 5 percent to more than 80 percent of the body weight in water. In only one of these species was there gas in the accessory respiratory organ in both normoxic and hypoxic water and only in this species did the organ have a definite hydrostatic function. The remaining air-breathing species used aerial respiration only in hypoxic water and there were differences between species in frequency of gulping for air and in partial pressure of oxygen in the water at which gulping was initiated. The evolution of a reduced swim-bladder volume appears to have been in response to a demersal mode of life.

76-001354 Harrington, R. W., Jr.; Crossman, R. A., Jr. TEMPERATURE-INDUCED MERISTIC VARIATION AMONG THREE HOMOZYGOUS GENOTYPES (CLONES) OF THE SELF-FERTILIZING FISH /RIVULUS MARMORATUS/. Can. J. Zool. 54 (7): 1143-1155. July 1976. In English with French summ. SFA 21(4)
[Fla. Med. Entomol. Lab., P.O. Box 520, Vero Beach, FL 32960]

76-001355 John, H.-C. ERGEBNISSE DER FORSCHUNGSREISEN DES FFS "WALTHER HERWIG" NACH SUEDAMERIKA. XLIII. LARVALFORMEN ATLANTISCHER EXOCOETIDEN. [RESULTS OF THE RESEARCH CRUISES OF FRV "WALTHER HERWIG" TO SOUTH AMERICA. XLIII. LARVAL FORMS OF ATLANTIC EXOCOETIDS.] Arch. Fischereiwiss. 26 (2/3): 115-135. Feb. 1976. In German with English summ. SFA 21(4)

The development of larvae and fry in some exocoetid genera was studied from a material of approximately 1500 larvae and juveniles, collected by neuston nets during the "Walther Herwig" cruise to South America in 1970/71. Excluding relative lengths of paired fins the morphological characteristics described for adults and bigger juveniles were proved valid even for smaller juveniles. Larvae can be distinguished to subfamily or partly genus level by the position of pelvic and anal fins, shape of head and relative body depth. These proportions partly showed allometric growth, which is described. Pigmentation of larvae sometimes may help in determination, but distribution data do not, for reproduction areas partly differ from the distribution areas of adults. In the South Atlantic our findings expand the formerly known distribution patterns further to the south. Larvae of the genera /Hirundichthys/ and /Danichthys/ could not be distingueshed, which rises the question, whether these genera should be separated.

76-001356 Laurent, P.; Dunel, S.; Barthe, J.-C. FUNCTIONAL ORGANIZATION OF THE TELEOST GILL. I. BLOOD PATHWAYS. Acta Zool. (Sweden) 57 (4): 189-209. 1976. SFA 21(4)

[Lab. Physiol. Comp. Reg., C.N.R.S., Strasbourg, France] The circulation of the gills has been studied in the perch, trout and eel combining the conventional histological methods and casting techniques. The existence of two blood pathways in each gill arch was confirmed. 1--An arterio-arterial pathway assuming the respiratory function. It includes the afferent branchial artery and in each primary lamella the afferent primary artery, the secondary lamellae capillaries and the primary and branchial efferent arteries. 2--An arterio-venous pathway arising from both the branchial artery, in the gill arch, and the primary arteries in each primary lamella. This pathway includes the central venous sinus of the primary lamella, several small veins and is finally connected with the branchial veins. 3--The lack of connections between afferent primary arteries and cvs in the trout and the perch makes impossible a direct blood flow from the afferent to the efferent artery (shunt). In eel connections between cvs and both afferent and efferent arteries do not mean that a shunt is operating according to the pressure gradient.

76-001357 Lund, W. A., Jr.; Marcy, B. C., Jr. EARLY DEVELOPMENT OF THE GRUBBY, /MYOXOCEPHALUS AENAEUS/ (MITCHILL). Biol. Bull. 149 (2): 373-383. Oct. 1975. SFA 21(4).
[Mar. Res. Lab., Univ. Conn., Noank 06340]

76-001358 Lundberg, J. G.; Marsh, E. EVOLUTION AND FUNCTIONAL ANATOMY OF THE PECTORAL FIN RAYS IN CYPRINOID FISHES WITH EMPHASIS ON THE SUCKERS (FAMILY CATOSTOMIDAE). Am. Midl. Nat. 96 (2): 332-349. Oct. 1976. SFA 21(4)

76-001359 Moore, C. J.; Burton, D. T. SOME SKELETAL ANOMALIES IN POTOMAC RIVER WHITE PERCH, /MORONE AMERICANA/ (GMELIN). ASB (Assoc. Southeast. Biol.) Bull. 22 (2): 69. Apr. 1976. SFA 21(4).
[Acad. Nat. Sci. Phila., Benedict Estuarine Res. Lab., Benedict, MD 20612] Examination of 42,936 white perch, /Morone americana/ (Gmelin), collected between September 1973 and November 1974 from the central Potomac River estuary, provided 98 (0.23 percent) instances of gross skeletal anomalies; other types of abnormalities were not observed. Visual examinations were made in the field and reported specimens represent only externally distinct cases. Radiographs showed kyphosis, lordosis, scoliosis and vertebrate fusion. Anomalous specimens ranged from 80 to 138 millimeters in standard length and were in their third to fifth year. Fin ray and scale counts of abnormal specimens were within the range found in typical Potomac River specimens. This is the first reported incidence of sketetal anomalies in white perch.

76-001360 Nagahama, Y.; Chan, K.; Hoar, W. S. HISTOCHEMISTRY AND ULTRASTRUCTURE OF PRE- AND POST-OVULATORY FOLLICLES IN THE OVARY OF THE GOLDFISH, /CARASSIUS AURATUS/. Can. J. Zool. 65 (7): 1128-1139. July 1976. In English with French summ. SFA 21(4)
[Dep. Zool., Univ. British Columbia, Vancouver, BC V6T 1W5, Canada]

76-001361 Sivak, J. G.; Gilbert, P. W. REFRACTIVE AND HISTOLOGICAL STUDY OF ACCOMMODATION IN TWO SPECIES OF SHARKS (/GINGLYMOSTOMA CIRRATUM/ AND /CARCHARHINUS MILBERTI/). Can. J. Zool. 54 (11): 1811-1817. Nov. 1976. In English with French summ. SFA 21(4)
[Lab. Comp. Optom., Univ. Waterloo, Waterloo, ON N2L 3G1, Canada] Refractive states were measured with a retinoscope in two species of sharks, before and after anaesthesia. Large refractive changes (up to 13 dioptres) were noted in /Ginglymostoma cirratum/, while lesser changes (up to 3 dioptres) were found in /Carcharhinus milberti/. The direction of refractive change (toward hyperopia with anaesthesia) agrees with the mechanism of accommodation described by Franz for elasmobranchs. Stimulation of the oculomotor nerve of /G. cirratum/ produces a partial reversal of the refractive change induced by anaesthesia. Histological study of the ventral ciliary body of both species indicates that contractile elements may be present. The density of these elements is maximum below points of apparent lenticular attachment.

PHYSIOLOGY

76-001362 Abell, P. R.; Burton, D. T. COLD SHOCK: THE EFFECT OF RATE OF THERMAL DECREASE ON THE SURVIVAL OF JUVENILE ATLANTIC MENHADEN (/BREVOORTIA TYRANNUS/). ASB (Assoc. Southeast. Biol.) Bull. 23 (2): 39. Apr. 1976. SFA 21(4).
[Acad. Nat. Sci. Phila., Benedict Estuarine Res. Lab., Benedict, MD] Rapid Temperature decreases encountered by fish during the winter from shutdown of industries with heated effluents have resulted in large kills. This study was initiated to assess the response of juvenile Atlantic menhaden (/Brevoortia tyrannus/) acclimated to 15°C and subjected to several rates of thermal decrease down to 5°C. The rates

76-001362 CONTINUED
of decrease were 0.0, 1.5, 3.0 and 6.0 hours. In all cases disorientation occurred as the temperature approached 5°C. No significant difference in the median time to death (i.e., time at which 50 percent mortality occurred at 5°C) was found for fish exposed to the four rates. The average median time to death was 46 hours (range 43-48 hours). The results of this study show that temperature appears to be more important than the rate of decrease when cold shock occurs within 6 hours.

76-001363 Arrington, R. W.; Sellers, C. M., Jr. THE EFFECTS OF TEMPERATURE UPON SELECTED VENTILATORY PARAMETERS OF RAINBOW TROUT, /SALMO GAIRDNERI/). Va. J. Sci. 27 (2): 42. 1976. Abstract only. SFA 21(4)
[Dep. Biol., Madison Coll., Harrisonburg, VA 22801] The effects of temperature upon ventilatory rate, ventilatory volume, and oxygen utilization were studied using rainbow trout, /Salmo gairdneri/, at 10, 15, and 20° C. Ventilatory activity is highest at 15°C. Correspondingly the lowest oxygen utilization is also at this temperature. The results confirm that changes in the amount of oxygen consumed by the organisms are brought about by alteration of ventilatory activity. Temperature exerts secondary effects upon oxygen utilization. These data suggest a complex lethal chain of events initiated by temperature elevation.

76-001364 Bouck, G. R.; Jacobson, J. ESTIMATION OF SALMONID SPERM CONCENTRATION BY MICROHEMATOCRIT TECHNIQUE. Trans. Am. Fish. Soc. 105 (4): 534-535. July 1976. SFA 21(4).
[U.S. EPA, West. Fish Toxicol. Stn., 1350 S.E. Goodnight Ave., Corvallis, Oreg. 97330] Field-centrifuged, packed sperm volumes provide quick, reliable estimates of sperm concentrations in salmonid semen.

76-001365 Bridges, D. W.; Cech, J. J., Jr.; Pedro, D. N. SEASONAL HEMATOLOGICAL CHANGES IN WINTER FLOUNDER, /PSEUDOPLEURONECTES AMERICANUS/. Trans. Am. Fish. Soc. 105 (5): 596-600. Sept. 1976. SFA 21(4).
[Div. Nat. Sci., St. Frances Coll., Biddeford, ME 04005] The hematology of adult winter flounder was investigated weekly from December 1972 through January 1974. The following parameters revealed statistically demonstrable variation between seasons: hemoglobin (Hb), blood oxygen capacity (CBO(2)), hematocrit (Hct), red blood cell number (RBC), Immature red blood cell number, mean corpuscular volume, mean corpuscular hemoglobin, leukocytes, lymphocytes, thrombocytes, neutrophils, condition factor, and apparent health. The blood constituents concerned with metabolic processes such as oxygen transport, e.g., Hb, Hct, CBO(2), and RBC, were lowest during late winter and early spring when winter flounder fast and undergo reproduction activity. At this time the constituents of the blood associated with stress response and infections, i.e., the total white blood cells, were at their yearly peak. The leukocyte count declined during the summer and remained low throughout the rest of the year. Conversely, the Hct, Hb, CBO(2), and RBC increased during the summer and remained high for the rest of the year. The variation in blood constituents may be in response to the stresses of fasting and spawning during the winter and the alleviation of stressing environmental conditions in the spring.

76-001366 Burton, D. T.; Moore, C. J.; Vansant, L. L.; Dayton, J. M. LETHAL LIMITS OF SHEEPSHEAD MINNOW EGGS (/CYPRINODON VARIEGATUS/) EXPOSED TO VARIOUS RATES OF THERMAL ELEVATION. ASB (Assoc. Southeast. Biol.) Bull. 22 (2): 44. Apr. 1976. SFA 21(4).

[Acad. Nat. Sci. Phila., Benedict Estuarine Res. Lab., Benedict, MD 20612] The thermal tolerance of /Cyprinodon variegatus/ eggs exposed to seven constant temperature increases was established for eggs spawned at 25°C. Temperatures were increased from 25C at the rates of 0.25, 0.50, 0.75, 1.00, 1.50, 1.75 and 2.00C/minute until cardiac failure occurred. Mean mortality temperatures at the slower heating rates of 0.25 and 0.50C/minute were significantly lower than those at the faster rates of 0.75, 1.00, 1.50, 1.75 and 2.00C/mintue. No significant difference was found between the mean mortality temperatures at the slower rates or at the faster rates. The mean lethal temperature at the two slower heating rates was 35.3C in contrast to 37.8C at the faster rates of thermal elevation. A significant difference was also found between the mean time to death at each rate with the exception of the means at 1.75 and 2.00C/minute. These findings suggest that acute heat death is a function of the rate of temperature change and/or time spent at a lethal temperature.

76-001367 Cech, J. J., Jr.; Bridges, D. W.; Rowell, D. M.; Balzer, P. J. CARDIOVASCULAR RESPONSES OF WINTER FLOUNDER, /PSEUDOPLEURONECTES AMERICANUS/ (WALBAUM), TO ACUTE TEMPERATURE INCREASE. Can. J. Zool. 54 (8): 1383-1388. Aug. 1976. In English with French summ. SFA 21(4)

[Div. Wildl. Fish. Biol., Univ. Calif., Davis 95616] Measurements of oxygen consumption rate, heart rate, total hemoglobin concentration, and arterial-venous blood pH, pressure, and oxygen tension and content were made on about 15 seasonally acclimatized winter flounder in flow-through respirometers at the seasonal mean temperatures of 5, 10, and 15°C. These data along with calculated values of cardiac output and stroke volume were compared with similar measurements in winter flounder exposed to a 5°C temperature increase over a 2-h period. To meet the significantly enhanced oxygen demand after the temperature increase, the primary cardiovascular adjustments changed from an increased arteriovenous (AV) O(2) content difference with no change in cardiac output at winter temperatures to an increased cardiac output and relatively unchanged AV O(2) difference at summer temperatures. Significantly increased heart rates also characterized the 5°C increase at each of the seasonal regimes. Seasonal fluctuations in blood oxygen capacity may be influencing the observed changes in cardiovascular adjustment patterns to temperature increase.

76-001368 Chesney, E. J., Jr.; Estevez, J. I. ENERGETICS OF WINTER FLOUNDER (/PSEUDOPLEURONECTES AMERICANUS/) FED THE POLYCHAETE, /NEREIS VIRENS/, UNDER EXPERIMENTAL CONDITIONS. Trans. Am. Fish. Soc. 105 (5): 592-595. Sept. 1976. SFA 21(4).

[Skidaway Inst. Oceanogr., P.O. Box 13687, Savannah, GA 31406] Age class I and II winter flounder, /Pseudopleuronectes americanus/, were fed the polychaete, /Nereis virens/, under experimental temperatures of 10 C and 20 C in a filtered (10 u), temperature-regulated seawater system for periods of 40 days. All the fish grew and there was no significant difference in growth between fish at 10 C and those at 20 C, but growth was significantly different (/P/ less than 0.05) between age classes at both temperatures. Age I fish had the higher growth efficiency and mean gross growth efficiencies based on calories were 23.7 percent and 20.2 percent for age I and II, respectively. Calculated efficiencies were lowest based on wet weight and generally increased when based on

76-001368 CONTINUED
dry weight, carbon, and caloric content.

76-001369 Conant, E. B.; Thomas, S. F. HISTOLOGICAL OBSERVATIONS OF THE REGENERATING LIMB IN THE AFRICAN LUNGFISH /PROTOPTERUS/. Va. J. Sci. 27 (2): 42. 1976. Abstract only. SFA 21(4)
[Dep. Biol., Mary Baldwin Coll., Staunton, VA 24401] The limb of the African lungfish, /Protopterus/, is characterized by an axial endoskeleton composed of articulating cartilage segments and is well supplied with muscles, nerves and blood vessels. Limbs readily undergo self-replacement and recent research has given us a description of the gross morphology of the regenerate. This study extends the description to a histological level. Following anesthesia in 1:900 MS-222, regenerated tissue was removed according to specific time intervals or lengths, fixed in Bouin's and stained in H & E or a tri-chrome stain. The following patterns were observed in the regenerating tissue. Migrating epidermis has covered the stump within 26 hours in the pectoral limb and 72 hours in the pelvic. In two cases the epidermis did not cover the severed cartilage, but invaginated, expelling the terminal cartilage fragment. By approximately two weeks a thickened apical cap has formed and by three weeks there is a well developed blastema. Cartilage does not show active growth until three weeks post amputation. Cartilage development is characterized by cell division, deposition of matrix and, ultimately, segmentation. Muscles, nerves and major blood vessels appear to establish themselves in a wave following cartilage growth. By 60 days in a pectoral regenerate, all of the tissues are well established, closely resembling the original limb.

76-001370 Conant, E. B. UREA ACCUMULATION AND OTHER EFFECTS OF ESTIVATION IN THE AFRICAN LUNGFISH, /PROTOPTERUS/. Va. J. Sci. 27 (2): 42. 1976. Abstract only. SFA 21(4)
[Dep. Biol., Mary Baldwin Coll., Staunton, VA 24401] Estivation was induced in 14 lungfish. X-rays and gross measurements were taken before and after estivation and, using a modified Conway microdiffusion technique, the level of urea was measured in seven different tissues, plus blood and bile. The data show that trends in weight loss and shrinkage correlate with length of estivation. Up to 30 percent of the initial weight may be lost after 17 months in the mud, less after shorter periods. Of the 10-15 percent decrease in body length, the larger decrement was in cloaca-tail measurement compared to snout-cloaca. Pectoral limbs shrank more than pelvics, e.g., 40 percent vs. 25 percent average after 17 months. X-rays corraborate the measurement data and show that skeletal elements undergo shrinkage. Axial cartilages change during limb shortening. Urea was found in all tissues, suggesting no storage site.--From abstr.

76-001371 Cristy, M. T. CONTROL OF VISUAL PIGMENT PROPORTIONS IN TWO ANADROMOUS FISHES. Ph. D. dissertation, Univ. Oreg. 164p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(3), 1976. SFA 21(4)
[To obtain copies write to the author at Dep. Zool., Univ. British Columbia, Vancouver, B.C., Canada]

76-001372 Czeczuga, B. CAROTENOIDS IN FISH IV. SALMONIDAE AND THYMALLIDAE FROM POLISH WATERS. Hydrobiologia 46 (2-3): 223-239. Mar. 1975. SFA 21(4)
[Dep. Gen. Biol. Med. Acad., Bialystok, Poland]

76-001373 de Vlaming, V. L. EFFECTS OF PHOTOPERIOD AND TEMPERATURE ON GONADAL ACTIVITY IN THE CYPRINID TELEOST, /NOTEMIGONUS CRYSOLEUCAS/. Biol. Bull. 148 (3): 402-415. June 1975. SFA 21(4).
[Dep. Biol., Marquette Univ., Milwaukee, WI 53233]

76-001374 Diener, D. R. HERMAPHRODITISM IN FISH: A COMPARATIVE STUDY OF THE REPRODUCTIVE BIOLOGY AND ENDOCRINOLOGY OF THE CALIFORNIA LABRIDAE. Ph. D. dissertation, Univ. Calif. (San Diego) 170p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(3), 1976. SFA 21(4)

76-001375 Drance, M. G.; Hollenberg, M. J.; Smith, M.; Wylie, V. HISTOLOGICAL CHANGES IN TROUT TESTIS PRODUCED BY INJECTIONS OF SALMON PITUITARY GONADOTROPIN. Can. J. Zool. 54 (8): 1285-1293. Aug. 1976. In English with French summ. SFA 21(4)
[Univ British Columbia, Vancouver, BC V6T 1W5, Canada] The histological changes produced in testes of immature trout (/Salmo gairdneri/) by biweekly injections of salmon pituitary gonadotropin have been studied. The hormone injections quickly induced spermatogenesis and mature sperm were present 12 weeks later. Sperm precursor cells formed in orderly progression and large numbers of cells at the same stage of development were present at each week during the cycle. At no time, however, after the first 2 weeks was a pure population of a single germ cell type present throughout the testis. Sertoli cells were identified for the first time in trout testis. The results revealed no significant differences in morphology of germ cells in the accelerated system from that previously described during normal maturation of trout testis. Therefore, hormonally accelerated spermatogenesis in trout appears to be an ideal system for biochemical analysis of the factors regulating and contributing to sperm maturation.

76-001376 Gerald, V. M. THE EFFECT OF TEMPERATURE ON THE CONSUMPTION, ABSORPTION AND CONVERSION OF FOOD IN /OPHIOCEPHALUS PUNCTATUS/ BLOCH. Hydrobiologia 49 (1): 87-93. Apr. 1976. SFA 21(4)
[Dep. Biol. Sci., Madurai Univ., Madurai-21, Tamilnadu, India] The overall feeding rate is maximum at 28°C and decreases at 20°C for all sizes. The smaller fish are cold-sensitive. At 28°C and at 33°C the time course rate shows the same decline, whereas at 20°C the response was anomalous. Absorption efficiency is independent of size and temperature. Rate of absorption and hence rate of conversion is primarily conditioned by rate of feeding. At 20°C the conversion efficiency is directly related to size whereas at 28°C and 33°C it is inversely related to size.--From abstr.

76-001377 Gerald, V. M. THE EFFECT OF SIZE ON THE CONSUMPTION ABSORPTION AND CONVERSION OF FOOD IN /OPHIOCEPHALUS PUNCTATUS/ BLOCH. Hydrobiologia 49 (1): 77-85. Apr. 1976. SFA 21(4)
[Dep. Biol. Sci., Madurai Univ., Madurai-21, Tamilnadu, India] The overall rate of feeding at 28°C bears an inverse relationship to size; the time course of feeding appears to be size-independent and shows a decline with increase in time. Absorption efficiency is independent of size. The rates of absorption and conversion and conversion efficiency are inversely related to size. The rate of feeding is reflected on the

76-001377 CONTINUED
rates of absorption and conversion.--From abstr.

76-001378 Golovanenko, L. F.; Shuvatova, T. F.; Arakelova, A. L. QUALITATIVE EVALUATION OF THE SEXUAL PRODUCTS OF THE BREAM (/ABRAMIS BRAMA/) FROM BIOCHEMICAL AND HISTOLOGICAL INDICATORS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 499-502. 1975. SFA 21(4)
[AzNIIRKh, Rostov-on-Don, USSR] More than 70 thousand bream (/Abramis brama/) spawners are annually procured by the Don hatcheries; the yield of young per female does not exceed 11 percent. Among the factors that influence the effectiveness of the artificial propagation of semidiadromous fishes, the state of the gonads, their maturity level and the presence or absence of signs of oocyte resorption are most important.

76-001379 Hamor, T.; Garside, E. T. DEVELOPMENTAL RATES OF EMBRYOS OF ATLANTIC SALMON, /SALMO SALAR/ L., IN RESPONSE TO VARIOUS LEVELS OF TEMPERATURE, DISSOLVED OXYGEN, AND WATER EXCHANGE. Can. J. Zool. 54 (11): 1912-1917. Nov. 1976. In English with French summ. SFA 21(4)
[Dep. Biol., Univ Waterloo, Waterloo, ON N2L 3G1, Canada] Embryos of Atlantic salmon, /Salmo salar/ L., were incubated from fertilization to completion of hatching at 5 and 10°C, at 20, 50, and 100 percent air-saturation, and at several rates of water exchange from 0.2 to 15 ml/s. Development rate to various structural stages, expressed as the reciprocal of time units, and hatching time were significantly controlled by temperature, oxygen supply, and rate of water exchange. Survival during embryogenesis and during the hatching period were limited primarily by oxygen supply and secondarily by water exchange, both having highly significant effects. The effect of temperature ranked third but was also statistically significant. Lower temperature reduced the rate of development and enhanced survival through hatching. Developmental rate and survival increased directly with increasing concentration of dissolved oxygen and with increasing rate of water exchange.

76-001380 Hendricks, J. D.; Hunter, L. J.; Wales, J. H. POSTMORTEM BILE DAMAGE TO RAINBOW TROUT (/SALMO GAIRDNERI/) LIVERS. J. Fish. Res. Board Can. 33 (11): 2613-2616. Nov. 1976. In English with French summ. SFA 21(4).
[Dep. Food Sci. Technol., Oreg. State Univ., Corvallis 97331] Peripheral liver necrosis in rainbow trout (/Salmo gairdneri/) was shown to result from pre- or postmortem exposure to bile. Accidental spillage of bile onto the liver during sampling or intentional submersion of liver tissue into bile resulted in a time-dependent destruction of liver tissue. Awareness of this caustic property of bile should prompt extreme care in the collection of trout livers for histology.

76-001381 Hilge, V.; Conrad, C. ZUM LAICHVERMOEGEN EINES HERMAPHRODITEN KARPFENS (/CYPRINUS CARPIO/). [ON THE SPAWNING CAPACITY OF A HERMAPHRODITE CARP (/CYPRINUS CARPIO/).] Arch. Fischereiwiss. 26 (1): 49-51. Aug. 1975. In German with English summ. SFA 21(4)
[Inst. Kusten- Binnenfisch. Bundesforschingsanst. Fisch., Hamburg, West Germany] A note is given on a hermaphrodite carp, who spawned six times within four months. His gonads are described macroscopically and microscopically.

76-001382 Hopkirk, G.; Wills, R. B. H.; Townsend, P. R. SEASONAL VARIATION IN LIPID CONTENT OF EELS (/ANGUILLA AUSTRALIS/). Aust. J. Mar. Freshwater Res. 26 (2): 271-273. July 1975. SFA 21(4).
[Dep. Nutr. Food Sci., Univ. Otago, Dunedin, New Zealand] Changes in the lipid content of short finned eels (/Anguilla australis schmidtii/ Phillips) obtained from Lake Ellesmere, New Zealand, were determined. The lipid content of yellow eels increased once they resumed feeding after their winter 'hibernation' with the most rapid increase being in the first few weeks. The lipid content of silver eels was found to gradually decline with time.

76-001383 Houston, A. H.; Rupert, R. IMMEDIATE RESPONSE OF THE HEMOGLOBIN SYSTEM OF THE GOLDFISH, /CARASSIUS AURATUS/, TO TEMPERATURE CHANGE. Can. J. Zool. 54 (10): 1737-1741. Oct. 1976. In English with French summ. SFA 21(4)
[Dep. Biol. Sci., Brock Univ., St. Catharines, ON L2S 3A1, Canada] Goldfish acclimated to 3 and 23°C were characterized by two- and three-component hemoglobin systems, respectively. After acclimation to a diurnally cycling temperature regime (approximately 3 to approximately 23°C), specimens sampled at approximately 23°C and approximately 3°C were identical in terms of hemoglobin system complexity with those held at equivalent constant temperatures. abrupt transfer of fish acclimated at constant 23°C to 3°C, and vice versa, lead to appearance or disappearance of the minor component, G.1, within 3 h. In vitro cooling and warming of whole blood and hemolyzate samples indicated that hemoglobin system modification occurred under cell-free as well as cell-intact conditions. These observations suggest that previously observed quantitative variations in the hemoglobin systems of thermally acclimated teleosts may represent, in part at least, altered aggregation of preexisting subunits rather than /de novo/ hemoglobin synthesis and raise the possibility that teleostean hemoglobin systems may possess a capacity for rapid, adaptative reorganization after environmental temperature variation.

76-001384 Hunter, F. R. PERMEABILITY OF TROUT ERYTHROCYTES TO NONELECTROLYTES. biol. Bull. 151 (2): 322-330. Oct. 1976. SFA 21(4)
[Dep. Biol. Sci., Univ. Pacific, Stockton, CA 95211]

76-001385 Hyodo-Taguchi, Y.; Egami, N. CELL POPULATION CHANGE IN INITIATION OF SPERMATOGENESIS FOLLOWING EXPOSURE TO HIGH TEMPERATURE DURING SEXUALLY INACTIVE SEASONS IN THE TELEOST, /ORYZIAS LATIPES/. Annot. Zool. Jpn. 49 (2): 96-104. June 1976. SFA 21(4)
[Div. Biol., Natl. Inst. Radiol. Sci., Chiba 280, Japan] In winter the testis of /Oryzias latipes/ is inactive and does not contain spermatocytes at meiotic and postmeiotic stages and spermatids. Spermatogonia Ia, Ib and II do not proliferate in the testis. When the males were transferred to warm environment (25° C) from cold thermal surroundings (0 to 5° C), DNA synthetic activity in primary spermatogonia Ib and primary spermatocytes at preleptotene stage increased within 24 hours after the transfer. Two days after the transfer, multiplication of primary spermatogonia Ib and maturation division of primary spermatocytes had occurred. Four to six days after the transfer, a temporary decrease in spermatogonia Ib population was observed before the establishment of the steady state of continuous spermatogenesis.

76-001386 Kernehan, R. J. A BIBLIOGRAPHY OF EARLY LIFE STAGES OF FISHES. Ichthol. Assoc. Inc. Bull. No. 14. 190p. 1976. Available at $2.00 from author. SFA 21(4)
[Ichthyological Assoc. Inc., Box 286, RD 1, Middletown, DE 19709] The bibliography contains 2,190 citations of literature pertinent to spawning habits, development of fishes, studies of, and experiments on early life stages (eggs through young) of over 600 species. It is cosmopolitan in literature coverage but greatest emphasis was placed on recent literature (1950-1976) pertinent to species found in North America. All citations are numbered and are indexed by the species included within.

76-001387 Korniyenko, G. G. EARLY DEGENERATIVE CHANGES IN THE OOCYTES OF THE KUBAN SEVRYUGA (/ACIPENSER STELLATUS/). J. Ichthyol. (Engl. Transl. Vopr. Ikthiol.) 15 (3): 503-507. 1975. SFA 21(4)
[AzNIIRKh, Rostov-on-Don, USSR]

76-001388 Lebedeva, N. Ye.; Malyukina, G. A.; Kasumyan, A. O. THE NATURAL REPELLENT IN THE SKIN OF CYPRINIDS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 472-480. 1975. SFA 21(4)
[Dep. Ichthyol., Moscow Univ., Moscow, USSR] A natural olfactory-active repellent has been isolated from the skin of the minnow (/Phoxinus phoxinus/) by preparative gel chromatography on Sephadex. A water extract of the skin has been shown to contain three groups of substances possessing differing repellent activity. The fraction typified by the maximum repellent activity has been isolated and some of its physico-chemical properties established. Consideration is given to the properties and repellent action of the other two fractions. The properties of the fraction are shown to alter as a function of the different physiological state of the organism and of the season.

76-001389 Lizenko, Ye. I.; Sidorov, V. S.; Potapova, O. I. SEASONAL VARIATIONS IN THE LIPID COMPOSITION OF THE TISSUES AND ORGANS OF THE LARGE CISCO (/COREGONUS ALBULA/) IN KARELIAN LAKES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 465-472. 1975. SFA 21(4)
[Inst. Biol., Karelian Br., Acad. Sci., Petrozavodsk, USSR] Consideration is given to the seasonal variations of total lipids and the composition of lipid fractions in the muscles, liver, gonads, nerve tissue, swim bladder and gills of the cisco (/Coregonus albula/).

76-001390 Magid, A. M. A.; Babiker, M. M. OXYGEN CONSUMPTION AND RESPIRATORY BEHAVIOUR OF THREE NILE FISHES. Hydrobiologia 46 (4): 359-367. May 1975. SFA 21(4)
[Dep. Zool., Univ. Khartoum, Sudan] The respiratory behaviour and patterns of oxygen consumption of three Nile species have been investigated. /Tilapia nilotica/ showed a typical pattern of oxygen consumption with an ambient region, adaptive plateau and lethal region. Specimens of /Polypterus senegalus/ and /Clarias lazera/ (body weights 20-30 and 30-45 g respectively) showed patterns of consumption comparable to that of /Tilapia/. In larger specimens of the two species the adaptive plateau was either insignificant or completely absent. Specimens of /Polypterus/ and /clarias/ (20-30 g and 30-45 g respectively) could survive in waters saturated with oxygen (7.4 mg/l) but their tolerance to lower oxygen concentrations was limited. Larger specimens of /Polypterus/ and /Clarias/ failed to survive in oxygen saturated waters. The tolerance of /Tilapia nilotica/ to extremely low oxygen concentration is an adaptation of a tropical and completely aquatic species. /Polypterus/ and /Clarias/ resort to their

76-001390 CONTINUED
compensatory mechanisms only when the aquatic respiratory surface fails to satisfy their oxygen requirements.--From abstr.

76-001391 Marshall, W. S. EFFECTS OF HYPOPHYSECTOMY AND OVINE PROLACTIN ON THE EPITHELIAL MUCUS-SECRETING CELLS OF THE PACIFIC STAGHORN SCULPIN, /LEPTOCOTTUS ARMATUS/ (TELEOSTEI: COTTIDAE). Can. J. Zool. 54 (10): 1604-1609. Oct. 1976. In English with French summ. SFA 21(4)
[Dep. Zool., Univ. British Columbia, Vancouver, BC V6T 1W5, Canada] Although hypophysectomy did not affect the number of skin mucous cells of sculpins in 5 percent seawater (1.4°/oo salinity), there were fewer mucous cells in the gills, compared with intact and sham-operated controls. Infections of ovine prolactin (10 ug/g) maintained the number of gill mucous cells of the hypophysectomized fish at levels near that of sham-operated controls. The results are discussed in relation to the possible involvement of mucus secretion in teleost osmoregulation. An index method for easily estimating the number of mucous cells in the gill is described and evaluated.

76-001392 McKeown, B. A.; Peter, R. E. THE EFFECTS OF PHOTOPERIOD AND TEMPERATURE ON THE RELEASE OF PROLACTIN FROM THE PITUITARY GLAND OF THE GOLDFISH, /CARASSIUS AURATUS/ L. Can. J. Zool. 54 (11): 1960-1968. Nov. 1976. In English with French summ. SFA 21(4)
[Dep. Biol. Sci., Simon Fraser Univ., Burnaby, BC V5A 1S6, Canada] A number of experiments were conducted to investigate the effects of photoperiod and temperature on prolactin release from the goldfish pituitary gland. Fish were acclimated to different photoperiods and temperatures, and also were subjected to a change in either of these two parameters after different acclimation conditions. Serum and pituitary samples were collected and analyzed by radioimmunoassay for prolactin levels. In other experiments samples for prolactin analysis were taken every 3 h intermittently over a period of 3 days from fish that were acclimated to different photoperiod and temperature conditions. Longer photoperiods and higher temperatures caused pituitary prolactin release. Serum prolactin changed on a circadian rhythm and the rhythm was modified depending on the length of the photoperiod.

76-001393 Moore, R. H. SEASONAL PATTERNS IN THE RESPIRATORY METABOLISM OF THE MULLETS /MUGIL CEPHALUS/ AND /MUGIL CUREMA/. Contrib. Mar. Sci. 20: 133-146. Sept. 1976. SFA 21(4)
[Dep. Biol., Univ. S. Car., Coastal Carolina Coll., Conway 29526] Respiratory metabolism of striped mullet, /Mugil cephalus/, and white mullet, /Mugil curema/, was studied in relation to weight, temperature, and swimming speed. Both species exhibit a general pattern of seasonal acclimatization similar to that seen in other fish species. Likewise, regression coefficients relating oxygen consumption to the other variables were usually within published ranges, except for swimming speed coefficients for white mullet which were exceptionally high. These specific patterns of regression coefficients and metabolic rates are consistent and can be used to partially explain the differences in distribution and ecology observed between the two species of mullet. The seasonal distributions and abundances of the two species as well as their metabolic responses and temperature sensitivities all indicate that the white mullet is a more warm-adapted species than the antitropically distributed, eurythermal striped mullet.

76-001394 Morcz, I. Ye. METABOLISM OF THE RUSSIAN STURGEON (/ACIPENSER GULDENSTADTI/) FROM AROUND THE VOLGOGRAD POWER STATION DAM. J. Ichthycl. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 451-464. 1975. SFA 21(4)

[State Res. Inst. Lake River Fish., Volgograd, USSR] An account is given of the dynamics of the content of protein, nonprotein nitrogen, lipid, glycogen, phosphorus (total, inorganic and ATP) and dry matter in the muscles, liver and gonads of Russian sturgeon (/Acipenser guldenstadti/) spawners during the lengthy period (8-9 months) spent around the Volgograd power station dam. This whole period is typified by intensive metabolism, as a result of which the content of body-building and energy-providing substances is reduced in the muscles and liver and increased in the maturing oocytes and spermatozoa. Males and females differ appreciably both in the level of the content of the substances investigated in the muscles, liver and gonads, and in the dynamics of accumulation and expenditure.

76-001395 Nash, A. R. THE STRUCTURE AND FUNCTION OF SHARK HAEMOGLOBINS. Ph. D. dissertation, Univ. New South Wales (Australia) 1976. From Diss. Abstr. Int. B Sci. Eng. 37(4), 1976. SFA 21(4)

76-001396 Rajamani, M.; Job, S. V. FOOD UTILIZATION BY /TILAPIA MOSSAMBICA/ (PETERS): FUNCTION OF SIZE. Hydrobiologia 50 (1): 71-74. July 1976. SFA 21(4)

[Dep. Biol. Sci., Madurai Univ., Madurai-625021, India] Experiments were done with three size groups of /Tilapia mossambica/ (Peters) to study the rate of energy intake, absorption and conversion and absorption efficiency and conversion efficiency. Experimental animals were fed with beef /ad libitum/ for a period of 40 days. It was found that the rates of intake, absorption and conversion of energy were inversely related to size, whereas efficiencies of absorption and conversion were directly related to size. The reason for the marked difference in the efficiency of energy conversion between small and large size groups is discussed.

76-001397 Richardson, L. B.; Margrey, S. L.; Burton, D. T. THE EFFECTS OF SEVERAL RATES OF HYPOXIC STRESS ON THE MORTALITY OF ATLANTIC MENHADEN, /BREVOORTIA TYRANNUS/ (LATROBE). ASB (Assoc. Southeast. Biol.) Bull. 22 (2): 75. Apr. 1975. SFA 21(4).

[Acad. Nat. Sci. Phila., Benedict Estuarine Res. Lab., Benedict MD 20612] Atlantic menhaden (90-150 mm total length) acclimated to 28-30C and 6.0-7.5 mg O(2)/l were subjected to four rates of hypoxic stress designed to simulate possible dissolved oxygen sags. Concentrations were reduced from 6.0 to 0.0 mg O(2)/l in 6, 12, 24 and 48 hr. A continuous flow vacuum degassing system was used to produce deoxygenated water, rather than nitrogen gas which may cause gas bubble disease. The mean time to death was directly proportional to the rate in all cases, while the lethal oxygen concentration at each rate was the same. Mortality at all four rates occurred around a mean concentration of 0.4 mg O(2)/l. The results of this study show that the absolute oxygen concentration appears to be more important than the rate of dissolved oxygen reduction when oxygen sags occur between 6 and 48 hours.

76-001398 Richardson, L. B.; Margrey, S. L.; Burton, D. T. MORTALITY OF ATLANTIC MENHADEN (/BREVOORTIA TYRANNUS/) EXPOSED TO CHRONIC HYPOXIA. ASB (Assoc. Southeast. Biol.) Bull. 23 (2): 90. Apr. 1976. SFA 21(4).
[Acad. Nat. Sci. Phila., Benedict Estuarine Res. Lab., Benedict, MD] Atlantic menhaden (80-200 mm total length) acclimated to 27-28°C and approximately 6.0 mg O(2)l^{-1} were exposed to dissolved oxygen concentrations of 0.75, 1.0, 1.25 and 1.5 mg O(2)l^{-1} for 96 hours. Oxygen concentrations were reduced from 6.0 mg O(2)l^{-1} to the desired level at a rate of 0.25 mg O(2)$l^{-1}hr^{-1}$. A vacuum degassing system was used rather than nitrogen displacement techniques to avoid possible gas bubble disease. Preliminary analysis of the data indicate that the 96-hour LC(50) (i.e. the concentration at which 50 percent die) occurs at approximately 1.2 mg O(2)l^{-1}.

76-001399 Roberts, J. L. ACTIVE BRANCHIAL AND RAM GILL VENTILATION IN FISHES. Biol. Bull. 148 (1): 85-105. Feb. 1975. SFA 21(4).
[Dep. Zool., Univ. Mass., Amherst 01002]

76-001400 Robertson, J. D. OSMOTIC CONSTITUENTS OF THE BLOOD PLASMA AND PARIETAL MUSCLE OF /SQUALUS ACANTHIAS/ L. Biol. Bull. 148 (2): 303-319. Apr. 1975. SFA 21(4).
[Zool. Dep., Univ. Glasgow, Glasgow, Scotland, U.K.]

76-001401 Shiganova, T. A. POSTEMBRYONIC DEVELOPMENT OF /HYGOPHUM MACROCHIR/ (MYCTOPHIDAE, PISCES). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 429-437. 1975. SFA 21(4)
[Inst. Oceanol., Acad. Sci., Moscow, USSR] The article contains the first account of the postembryonic development of /Hygophum macrochir/, tracing morphogenesis, the sequence of ossification of the skeletal formations and the process of fin formation, and noting the pigmentation typical of each phase.

76-001402 Smith, R. J. F. SEASONAL LOSS OF ALARM SUBSTANCE CELLS IN NORTH AMERICAN CYPRINOID FISHES AND ITS RELATION TO ABRASIVE SPAWNING BEHAVIOUR. Can. J. Zool. 54 (7): 1172-1182. July 1976. In English with French summ. SFA 21(4)
[Dep. Biol., Univ. Saskatchewan, Saskatoon, SK S7N 0W0, Canada] Histological examination of skin from preserved specimens of nine species of cyprinoids and one catostomid revealed seasonal loss of alarm substance cells in the males from seven cyprinoid species and reduction in the females from two species. Six of these species have abrasive spawning behaviour, while the behaviour of the seventh species has not been extensively studied. This is taken as tentative evidence that seasonal alarm substance loss is related to abrasive spawning behaviour. Several species also show seasonal changes in mucus production and epidermal thickness.

76-001403 Sroczynski, S. UNTERSUCHUNGEN UEBER DIE WACHSTUMSGESETZMAESSIGKEITEN DES SEHORGANS BEIM HECHT (/ESOX LUCIUS/ L.). [INVESTIGATIONS ON THE GROWTH REGULARITY OF THE ORGAN OF SIGHT ON PIKE (/ESOX LUCIUS/ L.).] Arch. Fischereiwiss. 26 (2/3): 137-150. Feb. 1976. In German with English summ. SFA 21(4)
[Inst. Ichthyobiol. Binnenfisch. Agrotech. Akad. Olsztyn, Poland] Several parameters of dioptrical system, as also of the whole eye, were measured for pikes with body length ranging between 20 and 70 cm. The measurements were aimed at determining developmental tendencies of eyes, as concerns their functioning and structural proportions. It was

76-001403 CONTINUED
found that focal length of the crystalline lens was most important of all measured parameters. Most of the other parameters, among them the distances inside the eye chamber, refraction for the front range of vision, and sizes of iris, are strictly dependant on the focal length. Refraction, measured for 5 sections of the vision range, was found to decrease from front backwards. Accuracy of preserving the distance from the centre of crystalline lens to the retina decreases from the back forwards. The direction of tropic locomotion of pike coincides with the direction of highest myopy and highest stability of the relative distance from the centre of the crystalline lens to the retina. Basical distance of the binocular vision, i.e. the distance between centres of lenses in both eyes, increases during ontogeneses proportionally to body length, and exceeds the growths of focal length of lens.

76-001404 Weinberg, S. R.; LoBue, J.; Siegel, C. D.; Gordon, A. S. HEMATOPOIESIS OF THE KISSING GOURAMI (/HELCSTOMA TEMMINCKI/). EFFECTS OF STARVATION, BLEEDING, AND PLASMA-STIMULATING FACTORS ON ITS ERYTHROPOIESIS. Can. J. Zool. 54 (7): 1115-1127. July 1976. In English with French summ. SFA 21(4)

[Dep. Biol., Grad. Sch. Arts Sci., New York Univ., New York, NY 10003] Starvation and bleeding of the kissing gourami were found to induce a pronounced anemia. After 9 days of starvation there was a 45 percent decrease in the numbers of circulating erythrocytes, and within 24 h of bleeding a fish (1 percent of the body weight) there was a 39 percent decrease in the red cell count, which elicited a reticulocytosis and leukocytosis. The blood volumes remained unchanged in the starved or bled fish. When the 9-day-starved fish was used to evaluate the hematopoietic-stimulating capacity of different substances, plasma from normal fish decreased erythropoietic activity, while plasma from fish made anemic by bleeding or 1 International Reference Preparation unit of human urinary erythropoietin evoked erythropoietic and leukocytopoietic activities. The estimated minimal red cell life-span in this fish was found to be about 13 days. However, there was some evidence for the existence of a population of long-lived erythrocytes. The ^{59}Fe incorporation value per milligram of organ was highest in the spleen, with kidney and liver showing less activity. These studies not only provide information for the understanding of the regulatory mechanism(s) involved in blood cell production in the fish, but also present evidence of the existence in fish of intrinsic hemopoietic regulatory factors, possibly hormonal in nature.

76-001405 Wydoski, R. S.; Wedemeyer, G. A.; Nelson, N. C. PHYSIOLOGICAL RESPONSE TO HOOKING STRESS IN HATCHERY AND WILD RAINBOW TROUT (/SALMO GAIRDNERI/). Trans. Am. Fish. Soc. 105 (5): 601-606. Sept. 1976. SFA 21(4).

[Utah Coop. Fish. Res. Unit., Utah State Univ., UMC 52, Logan 84322] This study evaluated the physiological response of rainbow trout to hooking stress after being played under standardized conditions (0-5 min) and estimated the time needed for recovery (to 72 h). Plasma osmolality and chloride measurements were used to evaluate osmoregulatory disturbances and gill ion-exchange function, and plasma glucose was used as an index of the generalized nonspecific physiological stress response. Hooking stress caused more severe blood chemistry differences in hatchery fish than in wild trout. Also, hooking stress imposed a greater stress on larger than on smaller hatchery rainbow trout. Higher water temperatures aggravated the delayed hyperglycemia and hyperchloremia in both hatchery and wild trout but only about 3 days were needed for recovery at 4, 10, or 20 C.

76-001406 Zeitoun, I. H.; Ullrey, D. E.; Bergen, W. G.; Magee, W. T. MINERAL METABOLISM DURING THE ONTOGENESIS OF RAINBOW TROUT (/SALMO GAIRDNERI/). J. Fish. Res. Board Can. 33 (11): 2587-2591. Nov. 1976. In English with French summ. SFA 21(4).

[Dep. Anim. Husb., Mich. State Univ., East Lansing 48824] Rainbow trout (/Salmo gairdneri/) eggs were collected from three females, fertilized by the milt of two males per female, and incubated separately. Samples were taken before fertilization, at +0.5 h and on days 1, 1.5, 3, 4, 5, 13, 17, 21, at hatching (23 days), and on day 37, immediately after postyolk absorption. The water environment contributed an estimated minimum 26 percent of the Na, 30 percent of the Fe, and 13 percent of the Zn found at hatching. Derivation of Ca, Na, K, Fe, and Zn from the water environment at postyolk absorption was estimated to be at least 70, 76, 45, 68, and 2 percent, respectively. All the P and Cu at hatching and in the larva could have been derived from the unfertilized oocyte.

GENETICS, VARIATION STUDIES AND HYBRIDIZATION

76-001407 Dingerkus, G.; Howell, W. M. KARYOTYPIC ANALYSIS AND EVIDENCE OF TETRAPLOIDY IN THE NORTH AMERICAN PADDLEFISH, /POLYODON SPATHULA/. Science 194 (4267): 842-844. Nov. 1976. SFA 21(4).

[Sect. Ecol. Syst., Stimson Hall, Cornell Univ., Ithaca, NY 14853] A model chromosome number of 120 was obtained for the ancient fish, /Polyodon spathula/ (/Pisces: Chondrostei). The karyotype consists of 48 macrochromosomes and 72 microchromosomes. The microchromosomes are like those found in certain other primitive fishes as well as in reptiles and birds. The possibility that /Polyodon/ is a species of tetraploid origin is strongly suggested by the fact that the 120 chromosomes are easily arranged into 30 groups of four homologs each. Evolutionary comparisions are made with other primitive fish groups.

76-001408 Kanevskaya, N. K. VARIABILITY OF THE BREAM (/ABRAMIS BRAMA/) IN LAKES, RIVERS AND RESERVOIRS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 396-399. 1975. SFA 21(4)

[IEMEZh, Moscow, USSR] Consideration is given to the variability of a number of the meristic and morphological characters of the bream (/Abramis brama/) from various lakes, rivers and reservoirs. It is established that bream populations inhabiting different types of waters differ in the variability of morphological and most meristic characters. To judge by the mean value of the coefficient of variation, the variability of characters is greatest in lake bream.

76-001409 Kristiansson, A. C.; McIntyre, J. D. GENETIC VARIATION IN CHINOOK SALMON (/ONCORHYNCHUS TSHAWYTSCHA/) FROM THE COLUMBIA RIVER AND THREE OREGON COASTAL RIVERS. Trans. Am. Fish. Soc. 105 (5): 620-623. Sept. 1976. SFA 21(4).

[Oreg. Coop. Fish. Res. Unit, Dep. Fish. Wildl., Oreg. State Univ., Corvallis 97331] Genetic variation in chinook salmon (/Oncorhynchus tshawytscha/) from ten hatcheries along the Columbia River drainage and the Oregon coast was described from results of starch gel electrophoresis. Highly significant differences were found between spring and fall chinook in the Columbia River watershed. It was suggested that frequencies of malate dehydrogenase, tetrazolium oxidase, and phosphoglucomutase phenotypes may be influenced directly or indirectly by selective forces.

76-001410 Ryabov, I. N. EMBRYONIC AND LARVAL DEVELOPMENT OF CARP (/CYPRINUS CARPIO/) X "KOREAN SAWBELLY" (/HEMICULTER EIGENMANNI/) HYBRIDS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 438-450. 1975. SFA 21(4)

[Dep. Ichthyol., Moscow Univ., Moscow, USSR] An investigation has been made of the embryonic and larval development of intersubfamilial hybrids between the carp and the "Korean sawbelly". The viability of reciprocal hybrids was found to be different. The embryos perished after hatching in the "Korean sawbelly" (female) x carp (male) cross, but 38 percent of viable larvae were obtained on crossing a female carp with a "Korean sawbelly" male. The hybrids differed significantly from the parental species in the number of trunk segments, the length of the yolk sac and the size of the eyes. The hybrids were also distinctive in the extent of development of the circulatory system, the nature of pigmentation and behavior. The hybrid index shows that the hybrids are not intermediate, but deviate either toward the carp or toward the "Korean sawbelly" with respect to individual characters. There are also characters that fall outside the limits of the parental species.

76-001411 Vasil'yev, V. P. KARYOTYPES OF SOME FORMS OF THE ARCTIC CHAR, /SALVELINUS ALPINUS/ FROM KAMCHATKA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 374-386. 1975. SFA 21(4)

[Dep. Ichthyol., Moscow Univ., Moscow, USSR] Data are presented on karyotypes of populations of the Arctic char, /Salvelinus alpinus/, from Kamchatka. Individual and intraspecific chromosomal polymorphism was discovered. On the basis of the results obtained the relationships of the separate groups of Kamchatka chars are examined.

BEHAVIOR

76-001412 Beitinger, T. L. DIEL ACTIVITY RHYTHMS AND THERMOREGULATORY BEHAVIOR OF BLUEGILL IN RESPONSE TO UNNATURAL PHOTOPERIODS. Biol. Bull. 149 (1): 96-108. Aug. 1975. SFA 21(4).

[Argonne Natl. Lab., Argonne, IL 60439]

76-001413 Bernstein, J. W. ORGANIZATION OF PARENTAL CARE BEHAVIOR IN /CICHLASOMA NIGROFASCIATUM/ (GUNTHER). Ph. D. dissertation, Mich. State Univ. 56p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(2), 1976. SFA 21(4)

This research was designed to test the hypothesis that cichlid parents possess distinct behavioral STATES corresponding to natural developmental stages of their young and are thus incapable of accepting young whose development stage does not match the state of the parent. Three out of four criteria demonstrated that parents do not fully accept young of a different age and development stage. It therefore appears that /Cichlasoma nigrofasciatum/ parents possess behavioral states.--From abstr.

76-001414 Brown, J.; Green, J. M. TERRITORIALITY, HABITAT SELECTION, AND PRIOR RESIDENCY IN UNDERYEARLING /STICHAEUS PUNCTATUS/ (PISCES: STICHAEIDAE). Can. J. Zool. 54 (11): 1904-1907. Nov. 1976. In English with French summ. SFA 21(4)

[Dep. Biol., Memorial Univ., St. John's, NF A1C 5S7, Canada] Laboratory and field experiments showed that underyearling /Stichaeus punctatus/ are territorial, select a particular type of habitat, and exhibit the prior residency effect. Territories are established immediately after settlement from the plankton. Although underyearlings disappeared from the study area in November, laboratory data suggested that /S. punctatus/ are territorial for the first year of their benthic life. It is hypothesized that territoriality in underyearlings could result in selection for early settlement and may account for the relatively short period during which settlement occurs.

76-001415 DeMartini, E. E. THE ADAPTIVE SIGNIFICANCE OF TERRITORIALITY AND EGG CANNIBALISM IN THE PAINTED GREENLING, /OXYLEBIUS PICTUS/ GILL, A NORTHEASTERN PACIFIC MARINE FISH. Ph. D. dissertation, Univ. Wash. 298p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(3), 1976. SFA 21(4)

Egg cannibalism and year-round Type A (feeding, mating, sheltering) male territorial behavior was examined in the painted greening, /Oxylebius pictus/ Gill (Hexagrammidae), a rocky reef fish of the shallow northeastern Pacific Ocean. Both ecological and evolutionary implications of the behaviors were considered and analyzed in terms of the species' promiscuous, male guardian breeding system. This system was found to be selectively advantageous for both individual males and individual females. Neither territorial nor cannibalistic behavior, moreover, regulates greening population density as a consequence of individual selection. Experimental evidence from fish removals and correlative evidence from measurements of habitat suitability demonstrate that neither northern nor southern populations are in general (1) limited by space either with respect to shelter holes or suitable spawning sites, (2) generally limited by food on reefs, or (3) limited by territorial behavior. Egg cannibalism, moreover, could not be experimentally demonstrated to be density-dependent and therefore also is not potentially regulatory. Within- and between-latitude comparisons of life history parameters strongly suggest that painted greenling are predator-limited. Relatively unpredictable mortality of post-settlement fish, together with unpredictable larval recruitment from the plankton, apparently keeps the species below carrying capacity on reefs. The "adaptive compromise" breeding system furthermore provides an explicit example of maximization of individual success at the expense of population productivity.--From abstr.

76-001416 Dorn, P. B. SEVERAL ASPECTS OF THE ORIENTATION OF SOME FISH TO LIGHT: RESPONSE TO POLARIZED LIGHT IN GOLDFISH, AND RESPONSE OF SHARK TO LIGHT, CHEMICAL STIMULUS AND THEIR COMBINATION. Ph. D. dissertation, Texas A&M Univ. 127p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(3), 1976. SFA 21(4)

Polarotactic orientation of a teleost, /Carassius auratus/, and orientation of an elasmobranch, /Ginglymostoma cirratum/, in response to light, chemical stimulus, and their combinations were electronically monitored and analyzed. Goldfish responded to the e-vector of overhead, linear polarized light, by change in their mean locomotor orientation and their spatial distribution over time. Furthermore, the animals reacted to light intensity differences in both polarized and normal light with similar response. There was no difference in this response in either white or black background. Nurse sharks were found to be positively phototactic at light intensities of

76-001416 CONTINUED
1.87 watts/cm². In conditions presenting light and chemical stimulus and a combination of the two, positive phototaxis, positive chemotaxis, and interaction of both was demonstrated. There was no change in these responses during at least seven hours of exposure to the above conditions.

76-001417 Eggers, D. M. A SYNTHESIS OF THE FEEDING BEHAVIOR AND GROWTH OF JUVENILE SOCKEYE SALMON IN THE LIMNETIC ENVIRONMENT. Ph. D. dissertation, Univ. Wash. 231p. 1975. From Diss. Abstr. Int. B Sci. Eng. 37(2), 1976. SFA 21(4)

The objective of this work is to formulate a viable set of hypotheses relating to how the limnetic environment affects the growth and feeding behavior of juvenile sockeye salmon. The set of hypotheses is sufficiently defined so that the construction of a computer model which simulates the growth and feeding behavior based upon the ambient environment is possible. The synthesis has four major areas of process development: 1. Predator-prey process, which is addressed at determining the potential level of food (including species composition) consumed per unit time by actively feeding salmon. 2. Metabolism and growth process, which determines the portion of ingested ration which becomes embodied as growth. 3. Schooling process, which determines the effect of schooling on the rate of food intake. 4. Behavioral processes, which consider the ecological consequences of behavior (other than active feeding and schooling), including vertical movements and the behavior associated with low hunger levels. Cueing mechanisms for these behaviors including schooling are discussed. Mathematical representations of these processes are deduced from published theory or from information observed both in the laboratory or /in situ/. The processes developed here are intended to be applicable to all freshwater lakes that sustain runs of sockeye salmon.--From abstr.

76-001418 Figler, M. H.; Klein, R. M.; Peeke, H. V. S. THE ESTABLISHMENT AND REVERSIBILITY OF DOMINANCE RELATIONSHIPS IN JEWEL FISH, /HEMICHROMIS BIMACULATUS/ GILL (PISCES, CICHLIDAE): EFFECTS OF PRIOR EXPOSURE AND PRIOR RESIDENCE SITUATIONS. Behaviour 53 (3-4): 254-271. 1976. In English with German summ. SFA 21(4).

[Lab. Psychobiol., Dep. Psych., Univ. Calif. San Francisco]

76-001419 Fishelson, L. OBSERVATIONS OF BEHAVIOUR OF THE FISH /MEIACANTHUS NIGROLINEATUS/ SMITH-VANIZ (BLENNIIDAE) IN NATURE (RED SEA) AND IN CAPTIVITY. Aust. J. Mar. Freshwater Res. 26 (3)d 329-341. Nov. 1976. SFA 21(4).

[Zool. Dep., George S. Wise Cent. Life Sci., Tel Aviv Univ., Israel]
/Meiacanthus nigrolineatus/ Smith-Vaniz is a Nemophininae blenny, living sedentarily around the shallow-water corals of the Red Sea. Unlike intertidal blennies, individuals of this species feed and perform various types of behaviour in the open water above their rocky retreats or, as adults, above their territories. In this paper various types of behaviour are analysed.

76-001420 Gusar, A. G.; Kupriyanov, V. S. USE OF UNDERWATER TELEVISION TO STUDY THE BEHAVIOR OF FISHES IN LIGHT FIELDS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 519-521. 1975. SFA 21(4)
[AsCherNIRO, Kerch, USSR]

76-001421 Huntingford, F. A. A COMPARISON OF THE REACTION OF STICKLEBACKS IN DIFFERENT REPRODUCTIVE CONDITIONS TOWARDS CONSPECIFICS AND PREDATORS. Anim. Behav. 24 (3): 694-697. Aug. 1976. SFA 21(4)
[Zool. Dep., The University, Glasgow, Scotland G12 2QQ] Experiments are described which assess 'boldness' towards a pike and 'aggressiveness' towards conspecifics in sticklebacks in non-reproductive condition, with a newly-built nest and with a recently hatched brood of young. The level of both of these aspects of behaviour increased across the three conditions. The possibility that this covariance indicates shared internal causal factors for the response to predator and conspecific is discussed.

76-001422 Jahn, L. A. RESPONSES TO ODORS BY FINGERLING CUTTHROAT TROUT FROM YELLOWSTONE LAKE. Prog. Fish-Cult. 38 (4): 207-210. Oct. 1976. SFA 21(4).
[Dep. Biol. Sci., West. Ill. Univ., Macomb 61455] Behavioral responses of fingerling cutthroat trout (/Salmo clarki/) to extracts of homogenized cutthroat fingerlings (3.2 ppm) and water-packed tuna (3.3 ppm) were examined in aquariums, using cutthroat extract alone and tuna extract with reward (food) and punishment (tapping the aquarium to alarm the fish). Although cutthroat trout extract elicited no statistically significant response in behavior, experiments with tuna extract and reward indicated that normal and sham-operated fish responded, but anosmic fish did not. Experiments with tuna extract and punishment were inconclusive. The results indicate that fingerling cutthroat trout are capable of detecting odors before they leave their home streams and return to Yellowstone Lake.

76-001423 Klein, R. M.; Figler, M. H.; Peeke, H. V. S. MODIFICATION OF CONSUMMATOR (ATTACK) BEHAVIOR RESULTING FROM PRIOR HABITUATION OF APPETITIVE (THREAT) COMPONENTS OF THE AGONISTIC SEQUENCE IN MALE /BETTA SPLENDENS/ (PISCES, BELONTIIDAE). Behaviour 53 (1-2): 1-25. 1976. In English with German summ. SFA 21(4).
[Sch. Biol. Sci., Univ. Sussex, Brighton, England]

76-001424 Kramer, B. FLIGHT-ASSOCIATED DISCHARGE PATTERN IN A WEAKLY ELECTRIC FISH, /GNATHONEMUS PETERSII (MORMYRIDAE, TELEOSTEI). Behaviour 59 (1-2): 88-95. 1976. In English with French summ. SFA 21(4)
[Univ. Konstanz, Fachber. Biol., D-775 Konstanz, Postfach 7733, West Germany]

76-001425 Luckhurst, B. E.; Luckhurst, K. SOME INFAUNAL FISHES ASSOCIATED WITH THE SCLERACTINIAN CORAL /MADRACIS MIRABILIS/. Can. J. Zool. 54 (8): 1395-1397. Aug. 1976. In English with French summ. SFA 21(4)
[Dep. Zool., Univ. Alberta, Edmonton, AB T6G 2E9, Canada] Fifteen clumps of the coral /Madracis mirabilis/ were collected and examined for infaunal fishes. A total of 19 specimens of fishes representing five families was obtained. Most of the specimens were members of the families Gobiidae and Grammistidae.

76-001426 Maynard, P. R. ORIENTATION AND LOCOMOTOR BEHAVIOR OF TWO SPECIES OF SHARK IN RESPONSE TO DIFFERING LEVELS OF WATER FLOW. Ph. D. dissertation, Texas A&M Univ. 90p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(3), 1976. SFA 21(4)

Behavioral criteria, involving locomotor activity, were used to analyze the response of two species of shark, (/Negaprion brevirosteris/ and /Ginglymostoma cirratum/), with respect to decreasing flow rates. Behavior was monitored continuously under both uniform and varying water flow conditions through the use of photoelectric circuitry. Analysis of data under control conditions showed species differences in activity, while experimental conditions showed species specific responses to flow rates as low as 0.1cm/s. Although sensory systems are discussed, this work does not explore the method of perception, but rather, the capability of deriving orienting information from low levels of water flow.

76-001427 McKaye, K. R. SOME ASPECTS OF THE BEHAVIOR AND ECOLOGY OF THE CICHLID FISHES OF LAKE JILOA, NICARAGUA. Ph. D. dissertation, Univ. Calif. (Berkeley) 144p. 1975. From Diss. Abstr. Int. B Sci. Eng. 37(1), 1976. SFA 21(4)

The distribution and behavior of nine species of cichlid and one eleotrid predator, /Gobiomorus dormitor/ were examined in Lake Jiloa, Nicaragua. For two relatively short periods of the year, during the middle of both wet and dry seasons, competition for breeding sites between these fishes was intense. The first section of this thesis examines the temporal pattern of breeding, the bathymetric distribution of breeding pairs, the microhabitat selection of breeding sites and the sizes of breeding individuals of each species of cichlid in Lake Jiloa. The seasonal pattern of breeding was bimodal with a different species complex breeding in the wet season as contrasted to the dry. In the second section, I examine the distribution and behavior of gold and grey morphs of the Midas cichlid, /Cichlasoma citrinellum/, the dominant species in terms of biomass within the lake. In the final section I discuss the behavior of one species of cichlid, /Cichlasoma nicaraguense/, which guarded the young of the largest species of fish in the lake, /Cichlasoma dovii/. Survivorship of the predator's young is increased by the presence of the altruist. A model is given to explain this unusual behavior in terms of individual natural selection.--From abstr.

76-001428 Neproshin, A. Yu.; Kulikova, N. I. SOUND-PRODUCING ORGANS IN SALMONIDS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 481-485. 1975. SFA 21(4)

[IEMEZh, Acad. Sci., Moscow, USSR] It is demonstrated that salmon are able to make sounds in the form of splashes when emerging at the surface of the water and when constructing a redd. In the first case "croaking" and "rumbling" noises are also to be observed when atmospheric air is swallowed and transferred to the swim bladder. The same sounds may also be made when part of the air escapes from the bladder. Consideration is given to the way in which "drumming" sounds and noises of "sawing" type are produced. An account is given for the first time of the way in which the low-frequency vibrations to be observed in salmon in the pre-spawning and spawning periods are produced.

76-001429 Perrone, M., Jr. THE RELATION BETWEEN MATE CHOICE AND PARENTAL INVESTMENT PATTERNS IN FISH WHO BROOD THEIR YOUNG: THEORY AND A CASE STUDY. Ph. D. dissertation, Univ. Wash. 153p. 1975. From Diss. Abstr. Int. B Sci. Eng. 37(2), 1976. SFA 21(4)

The forms of parental investment (PI), i.e., efforts by parents to raise the likelihood of survival of offspring, of fish are described, and their probable adaptive value identified. A theory that links mating systems of fishes to PI patterns is developed. Mating behavior is shaped by several factors: (a) males can brood several batches of eggs at once, but females cannot; (b) individuals seldom can court and brood fry at the same time; (c) males can control access at spawning sites. Several predictions are borne out from a literature survey. (a) Live-bearers mate promiscuously. (b) When eggs, but not free-swimming fry, are brooded, males do it, and they guard multiple clutches. (c) Brooding of fry by males only is very rare, and involves several broods at once. (d) Monogamy occurs only when parents guard free-swimming fry. (e) Polygyny occurs when males provide spawning and brooding sites which protect females from predators. Hypotheses about courtship and parental behavior are tested using a population of a cichlid fish, /Cichlasoma maculicauda/, in Gatun Lake, Panama. Both sexes of a pair defend a territory around the brood. They treat intruders according to their ecological role, not their taxonomic identity. Conspecifics eat eggs and larvae of unguarded nests, while /Gobiomorus dormitor/ and /Cichla ocellaris/ eat free-swimming fry. Parents keep egg-predators away from the nest, but allow nonpredators to approach it. Parents attack /Cichla/ and /Gobiomorus/ when they approach to the distance from the brood from which they usually attack it. This distance differs for the two species of predators. Fry do not distinguish their parents from other /Cichlasoma/, but parents reject foreign fry and eat them. Families (parents and brood) are spaced so that fry are too far from nearby families to be attracted to them. Parental coloration probably serves to signal conspecifics to keep away from the parent or risk being attacked.--From abstr.

76-001430 Pitcher, T. J.; Partridge, B. L.; Wardle, C. S. A BLIND FISH CAN SCHOOL. Science 194 (4268): 63-65. 26 Nov. 1976. SFA 21(4).

[Sch. Biol. Environ. Sci., New Univ. Ulster, Coleraine, Northern Ireland] Vision is not required in order for fish to school. Five individual saithe, /Pollachius virens/, were able to join schools of 25 normal saithe swimming in an annular tank, while blinded with opaque eye covers. Test fish maintained position within the school indefinitely and responded to short-term movements of individuals within the school, although quantitative differences in reaction time and schooling behavior were noted. Five fish with lateral lines cut at the opercula were unable to school when wearing opaque eye covers. Although it is unlikely that blind saithe could school in the wild, the constraints of the apparatus permitted a demonstration of a role of the lateral line organ in schooling.

76-001431 Stasko, A. B.; Horrall, R. M. METHOD OF COUNTING TAILBEATS OF FREE-SWIMMING FISH BY ULTRASONIC TELEMETRY TECHNIQUES. J. Fish. Res. Board Can. 33 (11): 2596-2598. Nov. 1976. In English with French summ. SFA 21(4).

[Dep. Environ., Fish. Mar. Serv., Biol. Stn., St. Andrews, NB E0G 2X0, Canada] Rhythmic beats in ultrasonic signals from free-swimming fish fitted with continuous-wave transmitters were noted during tracking of four species. Such signal beats corresponded with visually observed tailbeats of salmon and are presumed to have resulted from a Doppler effect due to undulations of the body and tail. The beats cannot be detected from pulsed transmitters. Tailbeat frequencies of

76-001431 CONTINUED
white bass (/Morone chrysops/) were higher than those of salmon for the same swimming speed in body lengths per second.

76-001432 Steffel, S.; Dizon, A. E.; Magnuson, J. J.; Neill, W. H. TEMPERATURE DISCRIMINATION BY CAPTIVE FREE-SWIMMING TUNA, /EUTHYNNUS AFFINIS/. Trans. Am. Fish. Soc. 105 (5): 588-591. Sept. 1976. SFA 21(4).
[Lab. Limnol., Univ. Wis., Madison 53706] Captive kawakawa, /Euthynnus affinis/, were instrumentally conditioned to respond to an increase in temperature to determine discrimination abilities. Two fish yielded a discrimination threshold of 0.10 to 0.15 C. Thermal sensitivity of this high-seas pelagic fish is thus no more acute than that of inshore fishes and appears inadequate for direct sensing of weak horizontal temperature gradients at sea.

76-001433 Stuntz, W. E. HABITAT SELECTION AND GROWTH OF BLUEGILLS. Ph. D. dissertation, Univ. Wis. (Madison) 141p. 1975. From Diss. Abstr. Int. B Sci. Eng. 37(1), 1976. SFA 21(4)
Growth of individual bluegills was measured at daily rations of 1 percent and 4 percent of the wet body weight/day and when ration was in excess over the temperature range of 4° C to 34° C at 3° C intervals. Growth rate was highest at 19° C for fish receiving an ad libitum ration, 16° C on a 4 percent daily ration and 13° C on a 1 percent daily ration. Although growth was low conversion efficiency was high at 4° C and 7° C. Conversion efficiency was least at 10° C. Conversion efficiency peaked at 19° C. When receiving ad libitum bluegills were able to grow at all temperatures tested. Individual fish fed at rations of 0, 2, 4 and 6 percent of their body weight per day were allowed to thermoregulate in temperature preference shuttle-box aquaria. The median selected temperature for fish that were growing was 31.2° C. Fish losing weight, i.e., those fed 0 percent and 2 percent daily ration, selected 29.8° C. The selections made in the two variable experiments indicate that both light and temperature affected the selection of a habitat. Field observations of bluegill distribution and behavior were made by divers. During day bluegills were aggregated and in or near cover. At night bluegills dispersed and were in all areas of the lake. Activity and feeding were maximal at dawn and dusk although feeding did occur at low levels at other times of the daily cycle. During early spring when vegetation had not yet emerged to provide cover fish selected areas of shade or areas where cover was permanent such as at a beaver lodge or near a fallen tree. When cover was available light was not important in habitat selection. Substrate was important in habitat selection only during spawning season. Temperature did not appear to influence habitat selection in the field.--From abstr.

76-001434 Thresher, R. E. FIELD EXPERIMENTS ON SPECIES RECOGNITION BY THE THREESPOT DAMSELFISH, /EUPOMACENTRUS PLANIFRONS/, (PISCES: POMACENTRIDAE). Anim. Behav. 24 (3): 562-569. Aug. 1976. SFA 21(4).
[Rosenstiel Sch. Mar. Atmos-Sci., Univ. Miami, Miami, FL 33149] The threespot damselfish, /Eupomacentrus planifrons/, defends differently sized territories against individuals of different species. Tests were conducted in the field to determine the mechanism(s) by which this interspecific recognition occurs. It was found to be based largely on visual cues, the most important of which was body form. Both colour and movement had different effects for intra- and inter-specific intruders. Based on these data, it is proposed that different mechanisms underlie the recognition of and territorial defence against the two groups. Further, interspecific territoriality need not be an 'accidental' form of intraspecific

76-001434 CONTINUED
territoriality nor a transitional phase in the divergence of already established species, but, rather, may be a stable system based on the simple need to defend an area against non-related competitors.

LIFE HISTORIES-GENERAL WORKS

76-001435 Constantz, G. D. LIFE HISTORY STRATEGY OF THE GILA TOPMINNOW, /POECILIOPSIS OCCIDENTALIS/: A FIELD EVALUATION OF THEORY ON THE EVOLUTION OF LIFE HISTORIES. Ph. D. dissertation, Ariz. State Univ. 103p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(3), 1976.SFA 21(4)

76-001436 Kircheis, F. W. REPRODUCTIVE BIOLOGY AND EARLY LIFE HISTORY OF THE SUNAPEE TROUT OF FLOODS POND, MAINE. Trans. Am. Fish. Soc. 105 (5)d 615-619. Sept. 1976. SFA 21(4).
[Me. Dep. Inland Fish. Wildl., 34 Idaho Ave., Bangor 04401] The Sunapee trout (/Salvelinus alpinus/ L.) of Floods Pond, Maine, spawned in October and November when surface water temperatures dropped below 15 C. There was little sexual dimorphism. Sexes were present on the spawning area in nearly equal numbers. Spawning occurred at night in shallow (30 to 100 cm) water near the lake shore. Eggs were scattered over a boulder-strewn bottom. There was neither redd construction nor site preparation. The eggs were relatively large (5.08 mm) and negatively buoyant. Females had approximately 2,500 eggs/kg of body weight. In hatchery tests eggs eyed in about 50 days and hatched in 79-122 days at mean water temperatures ranging from 11.0-3.0 C. The yolk sac was absorbed in about two weeks and the fry immediately moved to deep water. All males were mature at age III+ and all females were mature at age IV+. Many females spawned in alternate years while most males spawned every year.

76-001437 Kukuradze, A. M.; Mariyash, L. F. INFORMATION ON THE ECOLOGY WILD GOLDFISH (/CARASSIUS AURATUS GIBELIO/) IN THE LOWER REACHES OF THE DANUBE. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 409-415. 1975. SFA 21(4)
[AzCherNIRO, Odessa, USSR] Consideration is given to two forms of the goldfish (/Carassius auratus gibelio/). Information is given on the size, weight, coefficient of maturity and times of maturation of the slow-growing and fast-growing forms of this species. An analysis is made of fecundity and the intermittency of spawning is established.

76-001438 Lalancette, L. M. STUDIES ON THE GROWTH, REPRODUCTION AND DIET OF THE WHITE SUCKER, /CATOSTOMUS COMMERSONI COMMERSONI/ (LACEPEDE), OF GAMELIN LAKE, CHICOUTIMI, QUEBEC. Ph.D. dissertation, Univ. Waterloo 1975. From Diss. Abstr. Int. B Sci. Eng. 36(5), 1975. SFA 21(4).
In order to study the growth of /Catostomus commersoni/ of Gamelin Lake, 11,367 specimens were captured from September 1969 to May 1972. The linear growth of newly hatched specimens was very rapid and there appeared to be a positive correlation between the daily increment and the water temperature. Immature fish displayed a rapid growth rate which was similar for both sexes. The growth of adult specimens was slower and differed between sexes; females were always slightly larger (8 mm) than males of the same age. Growth occurred from May to December while an average contraction of 3 mm was experienced during the winter. The length-weight relationship varied during the life span but was not directly influenced by sex. Annual increase in weight was

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slow. The maturity index, the condition factor and fat content showed cyclical seasonal variation and immature specimens displayed a rhythm similar to that of adults. There was no correlation between the condition factor and fat content. Histological slides of the gonads showed that differentiation occurred very early in both testes and ovaries, that spermatogenesis rapidly resumes after spawning and that white suckers reproduce each year. The sex-ratio on the spawning beds was 1:1. The larger specimens were the first to arrive on the spawning beds and they tend to mate together while smaller fish arrive later and pair up. Individual fecundity was very low. The food of newly hatched white suckers consisted exclusively of plankton. Older fish had a more varied diet. In 1970, the biomass of suckers was 160 kilograms per hectare; in 1971, it was 123 kilograms per hectare and in 1972, 135 kilograms per hectare. The annual survival rate has been established at 53 percent. Finally, the range of suckers was limited to an area of two hectares. These results compared with those of other workers, indicate that Gamelin Lake suckers were stunted and that the productivity of the lake was low.-- From abstr.

76-001439 Lee, R. L. G.; Power, G. ATLANTIC SALMON (/SALMO SALAR/) OF THE LEAF RIVER, UNGAVA BAY. J. Fish. Res. Board Can. 33 (11): 2616-2621. Nov. 1976. In English with French summ. SFA 21(4).
[Dep. Biol., Univ. Waterloo, Waterloo, ON N2L 3G1, Canada] The Leaf River supports the most northerly known population of anadromous Atlantic salmon (/Salmo salar/) in Canada. River growth averaged 40-50 mm/yr, smolts averaged 258 mm fork length (range 190-300 mm) and 5.3 yr (range 4+ to 7+). Many males matured in fresh water and either incurred heavy mortality or became residual. Sex ratios among smolts were 5:1 in favor of females and among adults 3:1 in favor of females. Female 2-sea-winter salmon accounted for 75 percent of the fresh-run fish. Upstream migration peaked in August: kelts were still resident in the river 11 and 12 mo later.

76-001440 Settles, W. H.; Hoyt, Robert D. AGE STRUCTURE, GROWTH PATTERNS, AND FOOD HABITS OF THE SOUTHERN REDBELLY DACE /CHROSOMUS ERYTHROGASTER/ IN KENTUCKY. Trans. Ky. Acad. Sci. 37 (1-2): 1-10. Mar. 1976. SFA 21(4)
[Sci. Dep., St. Mary's Coll., St. Mary's, KY 40063]
Various aspects of the biology of the southern redbelly dace /Chrosomus erythrogaster/ were intensively studied on a population in Ivy Creek, Warren County, Kentucky from 1971 to 1972. The normal life span of the southern redbelly dace was about 2 years with a few individuals living into the autumn of their third year (26-30 months). Males disappeared from the population slightly earlier than females. Age Group 0, or individuals in their first year, constituted 76.8 percent of the total catch. Growth in length was greatest during the first year of life while growth in weight was greatest during the second and third years. No statistically significant deviation was observed between the theoretical cubic response of growth in weight to length and that observed among the specimens of Ivy Creek. Coefficient of condition values were greater for males than females when gonad weight was excluded, but converse results were observed when the gonads of both sexes were included in the determinations. Seasonally, condition coefficients for both sexes were greatest during the spawning season, lower during the warmwater months, and lowest during the coldwater months. Food habits were generally nonspecific with combinations of algal forms (filamentous chlorophytes and diatoms), and organic detritus constituing the major gut contents. Aquatic insects were commonly found in the digestive tracts of larger specimens.

76-001441 Walker, R. E.; Applegate, R. L. GROWTH, FOOD, AND POSSIBLE ECOLOGICAL EFFECTS OF YOUNG-OF-THE-YEAR WALLEYES IN A SOUTH DAKOTA PRAIRIE POTHOLE. Prog. Fish-Cult. 38 (4): 217-220. Oct. 1976. SFA 21(4).

[S. Dak. Coop. Fish. Res. Unit., S. Dak. State Univ., Brookings, 57006] Growth and food of walleyes, /Stizostedion vitreum/, reared in a South Dakota pothole, were monitored from 13 June to 13 September 1973. Walleyes attained a mean total length of 167.1 mm (range, 125 to 200 mm) and a mean weight of 41.2 g. The growth rate was higher than that reported for first-year growth of walleyes in most northern lakes. Walleyes initially fed on /Diaptomus/, the largest zooplankter available, and then changed to fathead minnows, /Pimephales promelas/; after fathead minnows were depleted, the walleyes ate aquatic insects, amphipods, and leeches. Depletion of the fathead minnow population was followed by about a 17-fold increase in zooplankton density and about a 3.5-fold increase in Secchi disk water transparency.

76-001442 Wolfe, D. C.; Webb, B. F. SLENDER TUNA (/ALLOTHUNNUS FALLAI/ SERVENTY): FIRST RECORD OF BULK CATCHES, TASMANIA, 1974. Aust. J. Mar. Freshwater Res. 26 (2): 213-221. July 1976. SFA 21(4).

[Fish. Res. Lab., Taroona, Tas. 7006, Australia] Purse seine catches of 230 tonnes of slender tuna in Tasmania were made in June 1974. The species has heretofore been regarded as rare in Australian waters, and relatively uncommon elsewhere. Surface water temperatures during commercial fishing ranged from 12.0 to 14.0°C. Age estimates by otoliths suggested 4+ to 6+ years for lengths 69.0-91.0 cm. The length-weight relationship was $/W/ = 0.0000045/L/^{3.322}$. The tuna were feeding mainly on pelagic Crustacea. Gonad inspection showed that spawning had occurred recently. Three internal parasites (/Anisakis/ sp., Copepoda, Cestoda) were found in 89.3, 95.7 and 61.7 percent of the 46 fish examined. Fish flesh was extremely oily (10-50 percent), and mercury analysis have readings from 0.1 to 0.2 mg/kg.

POPULATION STUDIES, PRODUCTION, ETC.

76-001443 Carline, R. F. INFLUENCE OF RECRUITMENT RATES ON PRODUCTION BY THREE POPULATIONS OF WILD BROOK TROUT (/SALVELINUS FONTINALIS/ MITCHELL). Ph.D. dissertation, Univ. Wis. (Madison) 139p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(8), 1976. SFA 21(4).

Annual biomass ranged from 12 to 238 kg/ha and densities ranged from 388 to 7,590 trout/ha. Differences among populations were related to areas available for spawning and immigration rates. In two ponds minimum estimates of immigrating trout ranged from 488 to 4,395/ha per year. Instantaneous growth rates of Age 1 and older trout were not related to population densities either within or among populations, but mean lengths or weights in fall and weight increments from spring to fall were inversely related to density. Benthic invertebrates were the most important food items for all sizes of trout and forage fish were important to trout greater than 16 cm long. All sizes of trout utilized the same invertebrate groups, though in varying proportions. In one pond trout predation apparently had an impact on the benthic community. Harvest by the sport fisheries was size-elective. Fishing mortality in one pond increased with age of trout and was more than double natural mortality of Age 5 fish. Annual production among populations ranged from 26 to 331 kg/ha. Production was lowest in the pond with no spawning area and highest in the pond with a large spawning area. Age 0 trout accounted for 3 to 65 percent of annual

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production by all age groups. Production by individual cohorts was directly related to their biomass, even though weight increments were inversely related to cohort biomass. Population growth rates, when expressed as ratios of annual production to mean annual biomass, were inversely related to population biomass, suggesting that growth was density-dependent. Population growth rates were directly related to benthic biomass. From 13 to 69 percent of annual production was harvested by sport fisheries. Differences in annual production among populations was most influenced by recruitment rates and subsequent population biomass. --From abstr.

76-001444 Chapman, D. W. ACCUSTIC ESTIMATES OF PELAGIC ICHTHYOMASS IN LAKE TANGANYIKA WITH AN INEXPENSIVE ECHO SOUNDER. Trans. Am. Fish. Soc. 105 (5): 581-587. Sept. 1976. SFA 21(4).
[FAO, United Nations, Kigoma, Tanzania, Africa] A costly Simrad acoustical system, calibrated against fish biomass in a keep-net, yielded internally consistent estimates of pelagic ichthyomass in Lake Tanganyika (East Africa). An inexpensive sounder (Furuno), tested alongside the Simrad system, provided information which correlated reasonably well with data from the Simrad system. I did not rigorously demonstrate accuracy of either system. Indices of abundance for the inexpensive sounder, based on depth of fish layers or schools, echogram trace area, and a subjective estimate of trace density correlated sufficiently well with commercial ring-net catches that I could predict fishing success. The indices of fish abundance served also for studies of gross changes in fish distribution.

76-001445 Churchill, W. S. POPULATION AND BIOMASS ESTIMATES OF FISHES IN LAKE WINGRA. Wis. Dep. Nat. Resour. Tech. Bull. No. 93. 8p. 1976. SFA 21(4).
[Wis. Dep. Nat. Resour., Madison 53707] Between spring 1972 and spring 1974, the fish population of Lake Wingra in Dane County was studied as part of an ecosystem analysis of the lake drainage basin being conducted for the International Biological Program. Objectives of the study were to estimate numbers and biomass of the principal fish species in Lake Wingra and to estimate changes in numbers and biomass resulting from death and reproduction. The average standing crop of fish over 75 mm in length was found to be about 494 kg/ha. Most of this consisted of panfish, with about 75 percent of the biomass being made up by bluegill. Total biomass and species composition varied due to fluctuations in the reproductive success of the different species. From 1972 to 1974, the biomass of bluegill over 75 mm varied from 140 to 500 kg/ha, while numbers of bluegill over two years old varied from 7,000 to 25,000 ha. The bluegill population was dominated by a very large 1971 year class, with very little recruitment in 1972 or 1973. Other species showed similar variations in abundance.

76-001446 Clark, W. G. A STUDY OF THE VIRTUAL POPULATION OF THE PERUVIAN ANCHOVETA IN THE YEARS 1962-1972. Ph. D. dissertation, Univ. Wash. 351p. 1975. From Diss. Abstr. Int. B Sci. Eng. 37(2), 1976. SFA 21(4)

76-001447 Forney, J. L. ABUNDANCE OF LARVAL WALLEYES (/STIZOSTEDION VITREUM/) ESTIMATED FROM THE CATCH IN HIGH-SPEED NETS. IN Symposium on the Methodology for the Survey Monitoring and Appraisal of Fishery Resources in Lakes and Large Rivers. European Inland Fish. Advis. Comm., FAO, U.N. EIFAC/T23(suppl. 1): 581-589. 1976. In English with French summ. SFA 21(4)

[Dep. Nat. Resour., Cornell Univ., Ithaca NY 14850] High-speed Miller samplers have been used in Oneida Lake to estimate abundance of larval walleyes during the pelagic stage since 1966. Similarity between estimates from successive surveys in the same year and the existence of consistently higher larval populations in years when larvae were stocked demonstrated the reliability of the sampling scheme.

76-001448 Gunderson, D. R. POPULATION BIOLOGY OF PACIFIC OCEAN PERCH (/SEBASTES ALUTUS/) STOCKS IN THE WASHINGTON-QUEEN CHARLOTTE SOUND REGION, AND THEIR RESPONSE TO FISHING. Ph. D. dissertation, Univ. Wash. 153p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(2), 1976. SFA 21(4)

Production and catch per unit effort of Pacific ocean perch stocks in the Washington-Queen Charlotte Sound region have declined drastically in recent years, largely in response to Soviet and Japanese removals during 1966-69. Pacific ocean perch are ovoviviparous, and as such their populations lack the resilience of highly fecund, oviparous species such as the gadoids. At present, their ability to maintain even current levels of abundance is uncertain. Recruitment to the fishing grounds is not complete until relatively late in life, and the proportion of each age group vulnerable to fishing was estimated by stock for age groups 10 through 16. It was concluded that any yield per recruit analysis for Pacific ocean perch stocks must take these recruitment patterns into consideration if it is to be meaningful. The reproductive biology of /S. alutus/ was examined in detail, and estimates of the length and age at sexual maturation were obtained by stock. The effects of fishing on stocks of Pacific ocean perch were examined through an approach similar to the yield per recruit analysis that is commonly used in stock assessment, although the model and computer program developed for this study differ from conventional methods in that they enable estimation of exploitable biomass and population fecundity as well as yield per recruit. Compensatory mechanisms that would tend to restore population fecundity and recruitment to pristine levels were discussed, and the limits of some of these mechanisms were explored with the computer program mentioned previously. The results of this analysis suggested that past levels of exploitation went far beyond those levels that could be sustained by Pacific ocean perch stocks on a long-term basis. It was concluded that future rates of exploitation should be regulated so that the annual catch never exceeds 10 percent of the mean stock biomass on hand during the year.--From abstr.

76-001449 Johnson, L. ECOLOGY OF ARCTIC POPULATIONS OF LAKE TROUT, /SALVELINUS NAMAYCUSH/, LAKE WHITEFISH, /COREGONUS CLUPEAFORMIS/, ARCTIC CHAR, /S. ALPINUS/, AND ASSOCIATED SPECIES IN UNEXPLOITED LAKES OF THE CANADIAN NORTHWEST TERRITORIES. J. Fish. Res. Board Can. 33 (11): 2459-2488. Nov. 1976. In English with French summ. SFA 21(4).

[Dep. Environ., Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB R3T 2N6, Canada] The available data on the fish populations of 35 lakes in the Northwest Territories are examined. The lakes range in size from Great Bear Lake (31,156 km²) to Keyhole Lake (46 ha); they are situated between lat. 60 and 75° N, east from the Mackenzie River to the west coast of Hudson Bay. Lake trout (/Salvelinus namaycush/) and whitefish (/Coregonus clupeaformis/) form the main populations of the

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mainland lakes and together make up to 95 percent of the total catch. There is a trend towards importance of whitefish with decreasing severity of conditions. Most populations show a uni, bi-, or trimodal length distribution; age distributions are unimodal. No change in these distributions was observed over a large number of years in certain lakes. These populations are considered to have reached a climax condition comparable with a vegetational climax, and are therefore in equilibrium with their environment. All incoming energy is ultimately used in respiration to support a high biomass of fish.

76-001450 Paragamian, V. L. POPULATION CHARACTERISTICS OF NORTHERN PIKE IN THE PLOVER RIVER, WISCONSIN. Prog. Fish-Cult. 38 (3): 160-163. July 1976. SFA 21(4)
[Manchester Fish Hatchery, Rt. 2, Manchester, IA 52057] Population size, standing stock, growth, K-factors, total annual mortality, and survival of northern pike (/Esox lucius/) in the Plover River, Wisconsin, were determined. Information pertaining to population characteristics of northern pike inhabiting streams is nonexistent in fishery literature. The capture of 119 and recapture of 25 northern pike, 263 to 806 mm long, yielded a population of 54 pike per hectare or a standing stock of 28.9 kg/ha in three study segments. Recaptures indicated some movement of marked fish. Mean back-calculated length for fish of ages I-IV were 250, 438, 586, and 681 mm. Total annual mortality, calculated from a catch curve, was 62 percent for ages I-IV. K-factors ranged from 0.52-0.95 (mean, 0.63). Northern pike occupied the same stream segments as the more numerous smallmouth bass (/Micropterus dolomieui/) but were seldom collected in the same habitat. Standing stocks of smallmouth bass appeared to be limited by proportions of suitable habitat rather than by densities of northern pike.

76-001451 Sunada, J. S. AGE AND LENGTH COMPOSITION OF NORTHERN ANCHOVIES, /ENGRAULIS MORDAX/, IN THE CALIFORNIA ANCHOVY REDUCTION FISHERY, 1973-74 SEASON. Calif. Fish Game 62 (3): 213-224. July 1976. SFA 21(4).
[Calif. Dep. Fish Game, Sacramento] A record total of 109,394 megagrams (120,587 short tons) was landed in the California reduction fishery during the 1973-74 season. Age composition of the catch was dominated by age-group II (1971 year-class) although age-group III (1970 year-class) contributed a significant amount to southern California landings. Catch composition from central California was comprised mainly of age-groups I, II and III (1972, 1971 and 1970 year-classes).

SPAWNING HABITS AND MOVEMENTS, FECUNDITY, ETC.

76-001452 Baylis, J. R. A QUANTITAVE STUDY OF LONG-TERM COURTSHIP: I. ETHOLOGICAL ISOLATION BETWEEN SYMPATRIC POPULATIONS OF THE MIDAS CICHLID, /CICHLASOMA CITRINELLUM/, AND THE ARROW CICHLID, /C. ZALIOSUM/. Behaviour 59 (1-2): 59-69. 1976. In English with German Summ. SFA 21(4)
[Dep. Zool., Univ. Wis., Madison 53706] /Cichlasoma citrinellum/ is a cichlid fish found in the Great Lakes and crater lakes of Nicaragua. It is sympatric with /C. zaliosum/ in Lake Apoyo, a Nicaraguan crater lake. /C. zaliosum/ is confined to that lake and is closely related to /C. citrinellum; it probably arose from /C. citrinellum in Lake Apoyo. /C. labiatum is endemic to the Great Lakes and is also closely related to /C. citrinellum/. All three species have complex reproductive

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behavior involving a prolonged courtship with pair bondings, followed by a period of joint parental defense and care of the offspring. Fish from sympatric populations of /C. citrinellum/ and /C. zaliosum/ interbred and produced viable F(1) offspring in the laboratory, when given no choice except a mate of the opposite species. Given a choice, /C. citrinellum/ and /C. zaliosum/ from both allopatric and sympatric populations formed only homospecific pairs, but the allopatric test was not conclusive. /C. labiatum/ was tested in a mate choice situation with an allopatric population of /C. citrinellum/ and showed incomplete behavioral isolation. Ethological isolating mechanisms are sufficient to explain the maintenance of species isolation between /C. citrinellum/ and /C. zaliosum/ in a sympatric situation in Lake Apoyo.--Summ.

76-001453 Ivankov, V. N.; Mitrofanov, Yu. A.; Bushuyev, V. P. AN INSTANCE OF THE PINK SALMON (/ONCORHYNCHUS GORBUSCHA/) REACHING MATURITY AT AN AGE OF LESS THAN 1 YEAR. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 497-499. 1975. SFA 21(4)
[USSR Acad. Sci., Vladivostock, USSR]

76-001454 Payusova, A. P. A COMPARATIVE ANALYSIS OF THE CHARACTERISTICS OF THE SPAWING POPULATIONS OF TWO CLOSELY RELATED SPECIES OF THE ISSYK-KUL DACE OF THE GENUS /LEUCISCUS/. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.). 15 (3): 387-395. 1975. SFA 21(4)
[Biol. Fac., Moscow Univ., Moscow, USSR] The spawning populations of closely related species of the Issyk-Kul dace, the "chebak", /Leuciscus schmidti/, and the "chebachok", /l. bergi/, were investigated during their spawning period in the Cholpon-Ata Bay. The two species differ both in spawning times and size, weight, age and sex composition. These differences ensure reproductive isolation in sympatry.

76-001455 Taube, C. M. SEXUAL MATURITY AND FECUNDITY IN BROWN TROUT OF THE PLATTE RIVER, MICHIGAN. Trans. Am. Fish. Soc. 105 (4): 529-533. July 1976. SFA 21(4).
[Mich. Dep. Nat. Resour., Ann Arbor 48109] Sexual maturity in brown trout (/Salmo trutta/) of the Platte River begins in males when they are between 177 and 202 mm in length, and in females essentially when they are between 202 and 228 mm. At these sizes, incidence of maturity in the two sexes is the same, 35 percent. At age I, 32 percent of the males and 16 percent of the females are mature. Incidence is virtually 100 percent in males when they reach 253 mm or age III, and 100 percent in females at 304 mm or age IV. In the length range of 202-354 mm, the average number of eggs produced per female trout ranges from 241 to 936. The largest number found among 89 fish (202-472 mm) was 2,419. Although fecundity varies widely between individuals of similar size and identical age, it is, as a whole, positively correlated with both size and age. The formula for regression of egg number, /N/, on the length is: /N/ = 7.3 (total length, mm) - 1,498.8. The formula for egg number by age is: /N/ = 353.3 (age group) -155.7. Size of eggs also varies considerably between individual fish, but like fecundity, it is correlated with size and age of females; that is, the larger and older females produce the larger eggs. Average diameter of eggs from brown trout collected in September ranged from 3.2 to 4.8 mm among individual fish that were from 193 to 472 mm in length.

MOVEMENTS, SEASONAL AND DEPTH DISTRIBUTION, ETC.

76-001456 Begg, G. W. THE RELATIONSHIP BETWEEN THE DIURNAL MOVEMENTS OF SOME OF THE ZOOPLANKTON AND THE SARDINE /LIMNOTHRISSA MIODON/ IN LAKE KARIBA, RHODESIA. Limnol. Oceanogr. 21 (4): 529-539. July 1976. SFA 21(4).

[Marina da Gama, Box 10, Muizenberg, Cape Town 7945, South Africa] The numbers of zooplankton at the surface in the open waters of Lake Kariba increased at night. Of the dominant species, the most extensive migrations were shown by adults of /Mesocyclops leuckartii/; their nauplii did not show any distinct diurnal movements. /Bosmina longirostris/ exhibited similar, but lesser, movements. /Keratella tropica/, /Keratella cochlearis/, and /Trichocerca chattoni/ remained more or less static in the epilimnion throughout the study. For some months after turnover, certain zooplankters move from the floor of the lake to the surface (60 m) each day. When temperature stratification in the monomictic lake intensifies and the hypolimnion becomes devoid of oxygen, these migrations are limited to the depth of the thermocline. These movements are similar to those of the Tanganyika sardine /Limnothrissa miodon/.

76-001457 Cadwallader, P. L. HOME RANGE AND MOVEMENTS OF THE COMMON RIVER GALAXIAS, /GALAXIAS VULGARIS/ STOKELL (PISCES : SALMONIFORMES), IN THE GLENTUI RIVER, NEW ZEALAND. Aust. J. Mar. Freshwater Res. 27 (1): 23-33. Mar. 1976. SFA 21(4).

[Snob's Creek Freshwater Res. Stn., Private Bag 20, Alexandra, Vic. 3714, Australia] Two-hundred and twenty-nine post-juvenile /G. vulgaris/ from the Glentui River were marked with Alcian Blue dye administered to various fin combinations with a jet innoculator in March and April 1971, and their distribution examined by electric fishing at intervals until February 1972. After each survey all fish were returned to the river. Of 384 recaptures, 97 percent were taken within the sections of the river in which they were marked (length range of sections 24-68 m) or within 200 m of them, and only seven fish were recaptured in areas other than riffles, the normal adult habitat. Fish moved upstream to suitable spawning areas in July and August, but returned after spawning. A change in habitat from riffle to pool, caused by the build-up of water behind a fallen tree, resulted in fish modifying their home range by moving to adjacent riffles. Field and stream-tank observations suggested that newly hatched fish are swept downstream to quiet stretches, and stream-tank studies indicated that juveniles move back upstream to riffles.

76-001458 Davies, R. W.; Thompson, G. W. MOVEMENTS OF MOUNTAIN WHITEFISH (/PROSOPIUM WILLIAMSONI/) IN THE SHEEP RIVER WATERSHED, ALBERTA. J. Fish. Res. Board Can. 33 (11): 2395-2401. Nov. 1976. In English with French summ. SFA 21(4).

[Dep. Biol., Univ. Calgary, Calgary, AB T2N 1N4, Canada] Movements of mountain whitefish (/Prosopium williamsoni/) in the Sheep River were studied during 1972 and 1973. Movement patterns of young-of-the-year and immature whitefish are ill-defined. Although some adult mountain whitefish are nonmigratory, the majority are migratory and show complex movement patterns including spring feeding, summer feeding, prespawning, spawning, and postspawning-overwintering movements. Environmental factors affecting and/or controlling these movements are discussed.

76-001459 Templeman, W. TRANSATLANTIC MIGRATIONS OF SPINY DOGFISH (/SQUALUS ACANTHIAS/). J. Fish. Res. Board Can. 33 (11): 2605-2609. Nov. 1976. In English with French summ. SFA 21(4).

[Queen's Coll., St. John's, NF A1B 3R6, Canada] The first record of a west to east transatlantic migration of a tagged spiny dogfish (/Squalus acanthias/) is reported, 11 yr after liberation at St. Pierre Bank to recapture in the Shetland Isles--northern North Sea area. The most northward and eastward records of spiny dogfish in the northwest Atlantic are presented and discussed in relation to the probable frequency of transatlantic migration. It is concluded that transatlantic migration is not great but probably not highly unusual.

76-001460 Van Den Avyle, M. J. ANALYSIS OF SEASONAL DISTRIBUTION PATTERNS OF YOUNG LARGEMOUTH BASS (/MICROPTERUS SALMOIDES/) BY USE OF FREQUENCY-OF-CAPTURE DATA. J. Fish. Res. Board Can. 33 (11): 2427-2432. Nov. 1976. In English with French summ. SFA 21(4).

[Dep. Wildl. Fish. Sci., Texas A&M Univ., College Station 77843] Frequency-of-capture data indicated that behavioral patterns of tagged age II largemouth bass (/Micropterus salmoides/) influenced catchability with shoreline electrofishing so that mid-summer population estimates were too low. The population separated into offshore and shoreline groups during the summer, and there is evidence of persistence in habitat preference from one year to the next. Tests of catchability were based on the agreement between observed frequencies of capture and those predicted from a bivariate model that allowed mortality and migration during the study. Though frequency-of-capture data have been widely utilized in studies of terrestrial animal populations, this information has been generally ignored by fishery biologists.

76-001461 Woolcott, W. S.; Maurakis, E. G. THE SEASONAL DISTRIBUTION OF THREE MINNOWS (CYPRINIDAE) IN A PIEDMONT SECTION OF THE JAMES RIVER, VIRGINIA. Va. J. Sci. 27 (2): 52. 1976. Abstract only. SFA 21(4)

[Univ. Richmond, Richmond, VA 23173] An investigation was made of the seasonal nearshore distributions of three species of minnows (Cyprinidae), /Notropis analostanus/, /N. ardens/ and /N. hudsonius/ collected in an 8 km stretch of a Piedmont section of the James River near Bremo Bluff, Virginia. Fishes were collected by electrofishing from a boat within and outside a heated effluent created by a power station from July, 1973 to June, 1974. Abundance and percent occurrence data were used to analyze the seasonal distributions at nearshore areas for each species. /Notropis analostanus/ was equally abundant at ambient and elevated temperature locations throughtout the year except in the heated plume when temperatures exceeded 30 C during the summer. The greatest abundance of /N. ardens/ occurred at ambient temperature nearshore areas from early fall to spring. In the heated plume, maximum numbers were recorded in late fall. /Notropis hudsonius/ was most abundant at ambient temperature areas from the summer through the fall and avcided the plume area in the summer and early fall when temperatures exceeded 30 C.

FOODS AND FEEDING

76-001462 Adams, S. M. FEEDING ECOLOGY OF EELGRASS FISH COMMUNITIES. Trans. Am. Fish. Soc. 105 (4): 514-519. July 1976. SFA 21(4).

[Environ. Sci. Div., Oak Ridge Natl. Lab., Oak Ridge, TN 37830] The principal components in the diets of fishes utilizing eelgrass (/Zostera marina/) beds in the shallow water estuaries near Beaufort, North Carolina, were detritus, planktonic copepods, and epifaunal crustaceans. Food produced within the eelgrass beds such as eelgrass, crustaceans, gastropods, and detritus, could have accounted for approximately 56 percent by weight of the diet of the eelgrass fish community. Pinfish (/Lagodon rhombiodes/) under 35 mm feed primarily on planktonic copepods, thereafter detritus gradually replaced copepods. When pinfish reached a length of about 70 mm they became more omnivorous consuming a greater proportion of plant material and polychaetes. Changes in feeding habits may have been responsible for significant differences in the weight-specific caloric contents observed between three size groups of both pigfish and pinfish. All species except one did not feed in the beds at night even though biomass of all fish was twice as high at night than during the day. The eelgrass fish community does not appear to be food-limited because the total annual food production in the beds is greater than the total annual food consumption by the eelgrass macrofauna.

76-001463 Baker, A. M.; Fraser, D. F. A METHOD FOR SECURING THE GUT CONTENTS OF SMALL, LIVE FISH. Trans. Am. Fish. Soc. 105 (4): 520-522. July 1976. SFA 21(4).

[Dep. Zool., Univ. Md., College Park 20742] A technique for securing the gut contents of small, live fish consists of injecting water from a hypodermic syringe through the alimentary tract by means of a short tube that is inserted into the intestine at the anus. The gut contents are flushed out through the mouth. Experiments on killifishes, /Fundulus/ spp., indicate a nearly 100 percent efficiency in emptying the gut and no detrimental effects from multiple injections. The technique does not work equally well for all species of small fishes.

76-001464 Cadwallader, P. L. FEEDING RELATIONSHIPS OF GALAXIIDS, BULLIES, EELS AND TROUT IN A NEW ZEALAND RIVER. Aust. J. Mar. Freshwater Res. 26 (3): 299-316. Nov. 1975. SFA 21(4).

[Snob's Creek Freshwater Fish. Res. Stn., Private Bag 20, Alexandra, Vic. 3714, Australia] The feeding relationships of the common river galaxias, /Galaxias vulgaris/ Stokell, upland bully, /Gobiomorphus breviceps/ (/Stokell), long-finned eel, /Anguilla dieffenbachii/ Gray, short-finned eel, /A. australis schmidtii/ Phillips, and brown trout, /Salmo trutta/ L., were examined in the Glentui River, Canterbury, New Zealand in February, May and November 1971. With few exceptions, the same food organisms were utilized by all species, but the relative proportion of each food type in the diet varied between species. Kendall rank correlation coefficients indicated that the diets of native fish were dissimilar, with the exception of galaxiids and bullies in May, but in six out of nine comparisons involving the introduced trout, the coefficients indicated varying degrees of similarity with the diets of the native species. Since their feeding mechanisms and feeding localities are different, similarities in the diets of eels and trout, trout and bullies, and bullies and galaxiids can be regarded as giving rise to indirect competition. However, since trout (less than 200 mm long) and galaxiids occupy the same

76-001464 CONTINUED
microhabitat and feed in the same manner, similarity in their diets can be regarded as giving rise to direct competition. Such direct competition for food, combined with interspecific aggression and similar microhabitat requirements, may help to explain the reduction in abundance of other galaxiids in areas in which trout have been introduced.

76-001465 Cadwallader, P. L. THE FOOD OF THE NEW ZEALAND COMMON RIVER GALAXIAS, /GALAXIAS VULGARIS/ STOKELL (PISCES: SALMONIFORMES). Aust. J. Mar. Freshwater Res. 26 (1): 15-30. Mar. 1976. SFA 21(4).
[Fish. Wildl. Div., Minist. Conserv., 932 Bourke St., Melbourne, Vic. 3000, Australia] The food of the common river galaxias, /Galaxias vulgaris/ Stokell, inhabiting the Glentui River, Canterbury, New Zealand, was studied between June 1970 and November 1971. Basic food consisted of Ephemeroptera: particularly the larvae of /Deleatidium/ spp., /Coloburiscus humeralis/ and /Nesameletus ornatus/. Secondary food consisted of Elmidae (Coleoptera), terrestrial arthropods, and the larvae of Rhyacophilidae, /Hydropsyche colonica/, /Olinga feredayi/, /Pycnocentrodes aureola/ (Trichoptera), /Archichauliodes diversus/ (Megaloptera), Chironomidae and Simuliidae (Diptera). Other food items were considered to be incidental. Diet varied seasonally and with size of fish. Large fish tended to eat larger food items than small fish, and there was also an increase in variety of food items with increase in fish size. Recently hatched fish fed predominantly on dipteran larvae, changing to a mainly ephemeropteran diet on moving to the adult habitat. Diet did not change significantly with age in fish sampled in the same type of habitat. Male and female diets were very similar.

76-001466 Dickie, L. M. PREDATION, YIELD, AND ECOLOGICAL EFFICIENCY IN AQUATIC FOOD CHAINS. J. Fish. Res. Board Can. 33 (2): 313-316. Feb. 1976. In English with French summ. SFA 21(4).
[Dep. Oceanogr., Dalhousie Univ., Halifax, NS, Canada] Given constancy of biomasses and sizes of predators and prey, the basic ecological equations are used to show that relative predation rates must increase rapidly as trophic level in aquatic food-chains drops towards primary production. The implications of this conclusion for exploitation at different food-chain levels is discussed.

76-001467 Elliott, G. V. DIEL ACTIVITY AND FEEDING OF SCHOOLED LARGEMOUTH BASS FRY. Trans. Am. Fish. Soc. 105 (5): 624-627. Sept. 1976. SFA 21(4).
[U.S. FWS, South Cent. Reservoir Invest., Fayetteville, AR 72701] A school of largemouth bass (/Micropterus salmoides/) fry was observed and a sample of fry collected for stomach content analysis at 3-hour intervals throughout a 24-hour period. During most of the day, the location of the school changed little, and the fry fed continuously on limnetic zooplankters. The fry did not feed at night, but remained inactive and closely aggregated in one location.

76-001468 Engel, S. FOOD HABITS AND PREY SELECTION OF COHO SALMON (/ONCORHYNCHUS KISUTCH/) AND CISCO (/COREGONUS ARTEDII/) IN RELATION TO ZOOPLANKTON DYNAMICS IN PALLETTE LAKE, WISCONSIN. Trans. Am. Fish. Soc. 105 (5): 607-614. Sept. 1976. SFA 21(4).
[Dep. Nat. Sci., Univ. Mich., Dearborn 48128] Insects, large zooplankton, and some fishes were the main diet of coho salmon (/Oncorhynchus kisutch/) stocked in Pallette Lake, Wisconsin. From May to early July, coho (117-120 mm total length) were found inshore and in the epilimnion offshore and ate mostly winged flies, ants, and

76-001468 CONTINUED
beetles. In late July and August they were primarily captured in the metalimnion and selected some underyearling cisco (/Coregonus artedii/) and numerous large, rare zooplankton. The latter included /Chaoborus punctipennis/ larvae and pupae, /Leptodora kindtii/, and /Holopedium gibberum/. Coho were captured mainly inshore in November and consumed some underyearling cisco and adult hemipterans. Native cisco (129-260 mm) fed on small, seasonally abundant zooplankton. Copepods (chiefly /Cyclops bicuspidatus thomasi/) reached peak abundance in May-June and October-November, when they were the most important items in cisco stomachs. Cladocerans (especially /Chydorus sphaericus/, /Eosmina longirostris/, and /Daphnia/ spp.) reached peak abundance between June and August and were then the most abundant items eaten by cisco in the metalimnion. Rotifers, which reached peak abundance in June, were rarely eaten by cisco.

76-001469 Gosheva, T. D.; Slonava, S. A. THE FEEDING AND FOOD SUPPLY OF LARVAL WHITE SEA HERRING (/CLUPEA HARENGUS PALLASI MARIS-ALBI/). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 415-423. 1975. SFA 21(4)
[PINRO, Archangel, USSR] Differences are shown to exist in the nature of the feeding of larval White Sea herring in different bays. Zooplankton was fairly abundant in the protected part of Onega Bay and in Un'ya Bay, a sub-bay of Dvina Bay, in the years 1968-1972, but scanty in Mezen Bay in 1968 and 1971. It is suggested on the basis of the relative stability of food resources in the protected part of Onega Bay and in Un'ya Bay of Dvina Bay that food supply is a factor that has less influence on the survival of the herring and the strength of herring year-classes in these areas than in Mezen Bay.

76-001470 Lewis, G. E. SUMMER FOOD OF CHANNEL CATFISH IN A WEST VIRGINIA FLOOD CONTROL RESERVOIR. Prog. Fish-Cult. 38 (4): 177-178. Oct. 1976. SFA 21(4).
[W. Va. Dep. Nat. Resour., Romney 26757] A total of 625 stomachs of channel catfish (/Ictalurus punctatus/) from Bluestone Reservoir in West Virginia were examined from 30 May to 30 August 1972. Aquatic insects were the most frequently occurring food item in the 315 stomachs that contained food. Mayfly nymphs and dipterans made up the largest proportion of insects consumed. On the basis of frequency of occurrence, mussels were next in importance to insects. Detritus and crayfish were found in nearly equal numbers of channel catfish stomachs and were next in importance to mussels. Only three channel catfish stomachs contained fish. Results from this study and others suggest that diets of catfish from impoundments vary, depending on the physical characteristics of the impoundment.

76-001471 Lewis, G. E. SUMMER AND FALL FOOD OF SPOTTED BASS IN TWO WEST VIRGINIA RESERVOIRS. Prog. Fish-Cult. 38 (4): 175-176. Oct. 1976. SFA 21(4).
[W. Va. Dep. Nat. Resour., Romney 26757] Stomachs from 396 spotted bass (/Micropterus punctulatus/) were collected from June to October 1971-1973, from two U. S. Army Corps of Engineers impoundments in West Virginia. Crayfish were the most frequently eaten food from the 139 bass stomachs that contained food from Bluestone Reservoir. At Sutton Reservoir, fish--mainly young-of-the-year white crappies (/Pomoxis annularis/), black crappies (/P. nigromaculatus/), and bluegills (/Lepomis macrochirus/)--were the most frequently occurring food in the 143 stomachs containing food. Both fish and crayfish were represented in bass stomachs taken from various depths by vertical gill nets. The food contents of the stomachs were not noticeably different in bass of different lengths.

76-001472 Prince, E. D.; Gotshall, D. W. FOOD OF THE COPPER ROCKFISH, /SEBASTES CAURINUS/ RICHARDSON, ASSOCIATED WITH AN ARTIFICIAL REEF IN SOUTH HUMBOLDT BAY, CALIFORNIA. Calif. Fish Game 62 (4): 274-285. Oct. 1976. SFA 21(4).

[Dep. Fish. Wildl. Sci., VPI & SU, Blacksburg, VA 24061] The stomachs of 241 copper rockfish captured around an artificial reef in South Humboldt Bay, California, were collected from March 1971 through March 1972. Food habits were compared with fish age (size), season, and time of day. Copper rockfish can be best categorized as opportunistic carnivores. Crustaceans, followed by fish and molluscs, were the most important food groups in the copper rockfish diet in terms of volume, number, and frequency of occurrence, followed by fish and molluscs. Juvenile Dungeness crabs, /Cancer magister/, were the most important individual food item in terms of volume and frequency of occurrence. Food habits varied considerably with changes in copper rockfish age (size). Generally, copper rockfish relied less on reef associated food organisms as their age (size) increased. During the summer months, copper rockfish exhibited a low percentage of empty stomachs and a high average volume of stomach contents. This coincided with an increase in growth of copper rockfish during the summer on the Humboldt Bay artificial reef. Copper rockfish fed at least as much at night as they did during daylight hours.

76-001473 Prince, E. D.; Maughan, O. E.; Clement, G. L. THE FOODS OF CENTRARCHID FISHES ASSOCIATED WITH ARTIFICIAL TIRE REEFS IN SMITH MOUNTAIN LAKE, VIRGINIA. Va. J. Sci. 27 (2): 48. 1976. Abstract only. SFA 21(4)

[Dep. Fish. Wildl. Sci., VPI & SU, Blacksburg, VA 24061] The stomachs of 90 largemouth bass, 87 smallmouth bass, 99 large bluegill, and 111 small bluegill were collected from specimens taken around the artificial tire reefs in Smith Mountain Lake, Va., from June through October 1975. Reef fishes utilized the tire reef areas as a feeding station. Bass fed mostly on bluegill, however, they can be best categorized as opportunistic piscivorous carnivores. Bluegill fed primarily on plant material, Dipteran larvae, and bryozoans and are best categorized as opportunistic omnivores. White catfish eggs and fry were an important bluegill food in August. The addition of tire reef substrate provided additional attachment surface for aquatic macroinvertebrates and algae, and a site for deposition of white catfish eggs. These organisms were utilized directly by reef fishes as food. Installation of artificial tire reefs altered the availability of food to localized fish populations and subsequently shortened and modified the typical lentic food web in isolated areas of Smith Mountain Lake, Virginia.

76-001474 Roger, C.; Grandperrin, R. PELAGIC FOOD WEBS IN THE TROPICAL PACIFIC. Limnol. Oceanogr. 21 (5): 731-735. Sept. 1976. SFA 21(4).

[185 Av. de Fabrun, 06200 Nice, France] Analysis of stomach contents, feeding rhythms, vertical distributions, and day-night migrations of the successive links of a pelagic food chain leads to a functional model of the prevailing trophic relationships and to identification of basic mechanisms determining the food web structure. This model demonstrates the existence of processes which support the downward energy transfer and reduce the upward one.

76-001475 Shanbhogue, S. L. STUDIES ON FOOD AND FEEDING HABITS OF PEAMOUTH (/MYLOCHEILUS CAURINUS/) IN LAKE WASHINGTON. Ph. D. dissertation, Univ. Wash. 127p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(2), 1976. SFA 21(4)

Inearly spring peamouth were most active just after dusk and during the night. During late spring considerable activity was evident in the entire 24-hr period with relatively large catches at night. Peamouth were active during most of the day in early summer with intensive movement at night and early morning hours. Two activity peaks were noticed during late summer, one just after dusk and the other just before dawn. During the fall, peamouth were active only during the night. Peamouth in Lake Washington seem to feed at night during spring and fall, and during most hours of day in summer, and consumed about 1.8-2.6 percent of body weight per day. During spring peamouth feed on oligochaetes, bivalves, chironomid larvae and trichopteran larvae. The major food items found in the guts during summer were gastropods, oligochaetes, chironomid larvae and chironomid pupae. In the fall peamouth mostly feed on gastropods, oligochaetes, mysids, chironomid pupae, amphipods, and macrophytes. The food consumed by both sexes was similar and no major differences were noticed in the food habits of three length classes examined.--From abstr.

76-001476 Stein, R. A., Jr. SELECTIVE PREDATION, OPTIMAL FORAGING, AND RESOURCE DEPRESSION WITHIN THE PREDATOR-PREY INTERACTION BETWEEN FISH AND CRAYFISH. Ph. D. dissertation, Univ. Wis. (Madison) 213p. 1975. From Diss. Abstr. Int. B Sci. Eng. 37(1), 1976. SFA 21(4)

In laboratory aquaria, smallmouth bass influenced activity, substrate selection, behavior, and food consumption of crayfish of different sizes and sexes. In the presence of a predator, crayfish selected substrates affording most protection, significantly modified the frequency of various behavior patterns, and reduced their overall activity. Degree of response of crayfish appeared correlated with liability to predation, i.e., small, vulnerable crayfish were most affected whereas large, less vulnerable crayfish were least affected. Because male crayfish have larger chelae than females, they apparently were better able to defend themselves against predators; consequently, less vulnerable males did not modify their behavior as dramatically as females. Field observations correlated well with laboratory findings suggesting that predators affect distribution and behavior of crayfish in natural communities. In selectivity experments, when offered a choice of crayfish sizes on sand, smallmouth bass (25-30 cm) chose the smallest crayfish first, consuming animals in ascending order of size. From a group of similar-sized crayfish of different life stages, smallmouth bass selected some life stages over others. From both field and laboratory results, life stages ordered from low to high susceptibility were: berried females, Form I (FI, capable of breeding) males, females, Form II (FII, incapable of breeding) males, and recent molts. Susceptibility of these different life stages appeared closely correlated with their morphological, physiological, and behavioral traits.--From abstr.

76-001477 Talent, L. G. FOOD HABITS OF THE LEOPARD SHARK, /TRIAKIS SEMIFASCIATA/, IN ELKHORN SLOUGH, MONTEREY BAY, CALIFORNIA. Calif. Fish Game 62 (4): 286-298. Oct. 1976. SFA 21(4).

[Dep. Fish. Wildl., Oreg. State Univ., Corvallis 97331] Four hundred thirty-six leopard sharks, /Triakis semifasciata/, were collected in Elkhorn Slough, Monterey Bay, California from October, 1971, through November, 1972. Three hundred sixty-seven (84.2 percent) of the shark's stomachs contained identifiable food items which were analyzed as to frequency of occurrence, percentage of total volume, and numerical importance. The Index of Relative Importance (IRI),

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which combines the numerical, volumetric, and frequency of occurrence measurements of each prey item into one value, was used to rank the importance of each food item. Leopard sharks from Elkhorn Slough fed largely on crabs, clams, fish, fish eggs, and the echiuroid worm, /Urechis caupo/. Considerable variation occurred in the diets of different sized sharks. The yellow shore crab, /Hemigrapsus oregonensis/, was the most important food item for sharks under 90 cm (3 ft) total length but as they approached 90 cm, /Urechis caupo/ and fish eggs became increasingly important. /Urechis caupo/ was the most important species in the diet of sharks over 90 cm but various species of crabs, clams, and fish eggs were also important items. The diet of shards 120 to 130 cm (3.9 to 4.3 ft) was almost evenly divided between crabs, clams, fish, fish eggs, and /Urechis caupo/. Fishes were the most important food items in sharks 130 to 140 cm (4.3 to 4.6 ft). There was no significant difference between the diet of male and female leopard sharks of similar size. Leopard sharks were able to utilize a variety of food sources in Elkhorn Slough without being dependent on any one source.

76-001478 Virnstein, R. W. THE EFFECTS OF PREDATION BY EPIBENTHIC CRABS AND FISHES ON BENTHIC INFAUNA IN CHESAPEAKE BAY. Ph. D. dissertation, Coll. William and Mary in Va. 69p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(2), 1976. SFA 21(4)

The significance of large mobile predators in controlling the distribution and abundance of infauna in a shallow subtidal sand community was tested using manipulative field experiments. Blue crabs (/Callinectes sapidus/) and two species of bottom-feeding fishes, spot (/Leiostomus xanthurus/) and hogchoker (/Trinectes maculatus/), were either excluded from or confined to small areas using wire mesh cages. The infauna responded to decreased predation with a large increase in density and diversity within 2 months. The largest population increases were exhibited by opportunistic species, which are considered to be most subject to predation. Species whose populations were least affected by predation were those species which either live deep in or quickly retract into the sediment. For most species, recruitment was by planktonic larvae and growth was very rapid, individuals growing to maturity in only a few months. All species increased in exclosures, suggesting that their population densities are not controlled by competitive interactions. In this community, infaunal population sizes are limited by predation and not by food or space. Severe predation pressure and physical disturbances, particularly sediment instability, keep population levels far below the carrying capacity of the environment. The severe predation, and the rapid growth, short generation times, and rapid turnover rates of constituent populations, suggests that such infaunal communities, despite a low standing crop, are an important food source for predator species important to man.--From abstr.

76-001479 Walker, W. H. TROPHIC RELATIONSHIPS OF THE MOTTLED SCULPIN, /COTTUS BAIRDI/ IN A WOODLAND STREAM, LINESVILLE CREEK, CRAWFORD COUNTY, PENNSYLVANIA. Ph.D. dissertation, Univ. Pittsburgh 378p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(7), 1976. SFA 21(4).

Benthophagic relationships were quantified for 752 mottled sculpins, /Cottus bairdi/ Girard (Cottidae: Pisces) electroshocked biweekly from Linesville Creek in Northwestern Pennsylvania. An annual total of 6943 food organisms constituting 149,457 calories from 126 different taxa were divided among 18 orders. Members of the Osteichthyes made up more than 50 percent of the calories in the diet while Ephemeroptera occurred in every sample. Based upon known feeding interactions in the stream, the prey organisms were divided into five ingestion categories

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with the following respective annual percent numerical and caloric contributions: Algal consumers, 68 and 7; Animal consumers, 8 and 83; Detrital consumers, 5 and 8; Algal-detrital consumers 17 and 2; and Algal-animal consumers, 2 and 1. Ivlev's Index of Electivity calculated for both numbers and calories indicated consistent numerical selection for /Stenonema/ and caloric advantage mainly from other sculpins. The annual standing crop of /Cottus bairdi/ was 2.0 to 2.9 fish per square meter of riffle. The weighted annual amount of benthic material passed on to the sculpin population through ingestion was estimated to be approximately 107 k cal per square meter. --From abstr.

AGE AND GROWTH

76-001480 Alt, K. T. AGE AND GROWTH OF ALASKAN BROAD WHITEFISH, /COREGONUS NASUS/. Trans. Am. Fish. Soc. 105 (4): 526-528. July 1976. SFA 21(4).
[Alaska Dep. Fish Game, Div. Sport Fish., Fairbanks 99701] Age and growth data are presented on 341 Alaskan broad whitefish, /Coregonus nasus/, from the Porcupine River, Minto Flats, Holitna River, Imuruk Basin, and the Sagavanirktok River. Fish examined were 23-64 cm fork length and ranged in age from III to XIII. Broad whitefish from the Porcupine and Holitna rivers and Minto Flats were approximately 12 cm longer by age VII than Imuruk Basin and Sagavanirktok River fish. Length of growing season is proposed as the main reason for differences in growth of various populations. Males reached sexual maturity between ages V and IX and females between ages V to X.

76-001481 Coulston, P.; Maughan, O. E. AGE AND GROWTH OF LIGHTLY EXPLOITED POPULATIONS OF NATURALIZED BROWN AND RAINBOW TROUT IN A SMALL NORTH CAROLINA MOUNTAIN STREAM. Va. J. Sci. 27 (2): 43. 1976. Abstract only. SFA 21(4)
[Va. Coop. Fish Res. Unit, VPI & SU, Blacksburg, VA 24061] 86 brown and rainbow trout (/Salmo trutta/ and /Salmo gairdneri/) from Poplar Creek in western North Carolina were aged using scale analysis. The absence of Lee's phenomenon in the back-calculation of lengths for older age groups suggests that both populations are lightly exploited. The absence of observed fisherman in the spring and summer of 1975 and the spring of 1976 supports this hypothesis. Brown trout, the numerically dominant species, grew faster and lived longer than did rainbow trout (4 years vs. 5 years). Both species showed relatively slow growth with very few individuals reaching the legal size of 10 inches. No rainbow trout over 10 inches were captured.

76-001482 Rauck, G. JAHRESZEITLICHE VERAENDERUNGEN DES LAENGEN-GEWICHTS-VERHAELTNISSES AN SCHOLLEN DER OESTLICHEN NORDSEE. [SEASONAL CHANGES OF THE WEIGHT-LENGTH RELATIONSHIP OF PLAICE IN THE EASTERN NORTH SEA.] Arch. Fischereiwiss. 26 (1): 29-33. Aug. 1975. In German with English summ. SFA 21(4)
[Inst. Kusten- Binnenfisch. Bundesforschungsanst. Fisch., Hamburg, West Germany] From 1969-1974 5095 weight-length data of gutted male and female plaice was collected at Hamburg fish market in order to study the seasonal fluctuation of K ($K = (g \times 100)/l^3$). Differences in the seasonal pattern of the food condition of small and large plaice has been described. Small female plaice within the range of 26-40 cm show a falling tendency of K from August-September to April-May next year. From May onwards the K-values of these cm-groups increase to a maximum in autumn. Plaice of the 41-49 cm group show a similar pattern

76-001482 CONTINUED
up to July and increase further up to the end of the year as a result of the development of their gonads. In case of male plaice the variations of K throughout the year are much less than compared with female plaice.

76-001483 Raush, R. R. AGING IN THE NEVADA PUPFISH, /CYPRINODON NEVADENSIS/. Ph. D. dissertation, Ariz. State Univ. 112p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(3), 1976. SFA 21(4)
Pre-adult pupfish (/Cyprinodon nevadensis/) were studied in three different feeding experiments to determine the effect of age, size, and sampling (genetic make-up) on relative growth. It was hypothesized that relative growth is inversely related to age and size, and influenced by genetic differences in population samples. These hypotheses are supported by the statistically treated, experimental evidence. Age-related effects and size-related effects were separated in age comparisons by pairing on the basis of size. This procedure was possible because the growth of sampled fish groups was controlled by restricted feeding to produce different-aged populations with approximately the same weight-frequency distributions.

76-001484 Richards, S. W. AGE, GROWTH, AND FOOD OF BLUEFISH (/POMATOMUS SALTATRIX/) FROM EAST-CENTRAL LONG ISLAND SOUND FROM JULY THROUGH NOVEMBER 1975. Trans. Am. Fish. Soc. 105 (4): 523-525. July 1976. SFA 21(4).
[Little Harbor Lab., 69 Andrews Rd., Guilford, CN 06437] Age and growth were analyzed from scales of 64 bluefish taken from east-central Long Island Sound during mid-July to mid-November 1975. Ages ranged from 2+ to 7+ years; fork lengths ranged from 44 to 76 cm. No consistent differences were noted between the sexes. Back-calculations from scale readings indicated that mean fork lengths, in centimeters, for each year were: 23 at 1+ year; 40 at 2+ years; 49 at 3+; 48 at 4+; 64 at 5+; 69 at 6+; and 71 at 7+ years. Weight in grams doubled from 1,800 at 3+ years to 4,100 at 5+ years, increasing to 5,500 at 7+ years. Sixty-seven bluefish ate /Loligo peali/ (squid) and seven species of fish: /Brevoortia tyrannus/, /Anchoa mitchilli/, /Peprilus triacanthus/, /Etrumeus teres/, /Alosa pseudoharengus/, /Merluccius bilinearis/, and /Pomatomus saltatrix/. With the exception of menhaden, all prey were of small size, ranging in length between 5 and 20 cm.

76-001485 Sled', T. V. GROWTH RATE AND INCREASE IN BRAIN WEIGHT IN VARIOUS POPULATIONS OF ROACH /RUTILUS RUTILUS LACUSTRIS/ (PALLAS). Dokl. Akad. Nauk SSSR Biol. Sci. Sect. (Engl. Transl.) 226 (1-6): 13-16. Aug. 1976. SFA 21(4)
[Ural Sci. Cent., Acad. Sci. USSR, Sverdlovsk, USSR]

76-001486 Smith, M. A. K.; Thorpe, A. NITROGEN METABOLISM AND TROPHIC INPUT IN RELATION TO GROWTH IN FRESHWATER AND SALTWATER /SALMO GAIRDNERI/. Biol. Bull. 150 (1): 139-151. Feb. 1976. SFA 21(4)
[Dep. Biol., American Univ., Beirut, Lebanon]

GEOGRAPHICAL DISTRIBUTION, FISH SURVEYS, ETC.

76-001487 Aceituno, M. E.; Nicola, S. J. DISTRIBUTION AND STATUS OF THE SACRAMENTO PERCH, /ARCHOPLITES INTERRUPTUS/ (GIRARD), IN CALIFORNIA. Calif. Fish Game 62 (4): 246-254. Oct. 1976. SFA 21(4).
[BLM, P.O. Box 848, Los Angeles, CA 90053] California's only native centrarchid is virtually nonexistent in its native habitat: the waters of the Central Valley, the Clear Lake basin, and the Pajaro and Salinas rivers. However, it has been introduced and successfully established in a number of artificial environments and natural waters outside of its native range; thus, it is in no danger of becoming extinct. The history of its decline and transplanting is traced.

76-001488 Aceituno, M. E.; Caywood, M. L.; Nicola, S. J.; Pollitt, W. I. OCCURRENCE OF NATIVE FISHES IN ALAMEDA AND COYOTE CREEKS, CALIFORNIA. Calif. Fish Game 62 (3): 195-206. July 1976. SFA 21(4).
[BLM, U.S. Dept. Interior, Los Angeles, CA] The recent occurrence of native fishes in two San Francisco Bay tributaries is compared with that of earlier periods as revealed by collection records. Alameda Creek, despite intensive urban development, has retained a major portion of its native fish fauna. In contrast, lower Coyote Creek, under similar conditions has apparently lost over half of the fish species originally present.

76-001489 Allen, L. G. ADDITIONS TO THE LIST OF FISH SPECIES KNOWN FROM ALAMITOS BAY, CALIFORNIA, BASED ON STUDIES IN COLORADO LAGOON. Calif. Fish Game 62 (4): 310-314. Oct. 1976. SFA 21(4).
[Dep. Biol., Calif. State Univ., Fullerton 92634]

76-001490 Allen, M. J. ADDITION OF /CITHARICHTHYS FRAGILIS/ GILBERT TO THE CALIFORNIA FAUNA. Calif. Fish Game 62 (4): 299-303. Oct. 1976. SFA 21(4).
[South. Calif. Coastal Water Res. Proj., El Segundo 90245]

76-001491 Begg, G. W. SOME NOTES ON THE SANDVLEI FISH FAUNA, MUIZENBERG, CAPE. Piscator No. 96. 4-14. 1976. SFA 21(4)

76-001492 Behrstock, R. A. FIRST RECORD OF THE DECORATED WARBONNET, /CHIROLOPHIS DECORATUS/ (JORDAN AND SNYDER 1902), IN CALIFORNIA WATERS. Calif. Fish Game 62 (4): 308-309. Oct. 1976. SFA 21(4).
[Dep. Fish., Sch. Nat. Resour., Humboldt State Univ., Arcata, CA 95521]

76-001493 Bishop, F. G. A NEW DISTRIBUTION RECORD FOR BRASSY MINNOW IN NORTHWESTERN ALBERTA. Can. Field-Nat. 89 (3): 319-320. July-Sept. 1975. SFA 21(4)
[Alberta Dep. Lands Forests, Box 1348, Peace River, AB T0H 2X0, Canada]

76-001494 Bishop, F. G. OBSERVATIONS ON THE FISH FAUNA OF THE PEACE RIVER IN ALBERTA. Can. Field-Nat. 89 (4): 423-430. Oct.-Dec. 1975. SFA 21(4)

[Alberta Dep. Lands Forests, Box 1348, Peace River, AB T0H 2X0, Canada] The distribution and relative abundance are shown for 22 species of fishes collected in the Alberta portion of the Peace River. Limited growth data and general observations are given for 10 of the larger-growing species: Dolly Varden, Arctic grayling, goldeye, northern pike, flathead chub, squawfish, longnose sucker, white sucker, burbot, and walleye. Concentrations of chlorinated insecticides and mercury in some of the more important species of fish in the river were found to be quite low.

76-001495 Collins, M. A. J. THE LUMPFISH (/CYCLOPTERUS LUMPUS/ L.) IN NEWFOUNDLAND WATERS. Can. Field-Nat. 90 (1): 64-67. Jan.-Mar. 1976. SFA 21(4)

[Mar. Sci. Res. Lab., Memorial Univ., St. John's, NF, Canada]

76-001496 Cross, J. N. STATUS OF THE NATIVE FISH FAUNA OF THE MOAPA RIVER (CLARK COUNTY, NEVADA). Trans. Am. Fish. Soc. 105 (4): 503-508. July 1976. SFA 21(4).

[Coll. Fish., Univ. Wash., Seattle 98105] The Moapa River of eastern Clark County, Nevada was surveyed in January 1974 and August 1975 to determine the status of the native fishes. Thirteen species were collected; four are native to the Moapa River. Two nonnative species not previously recorded were collected. The abundance and range of two native species, /Moapa coriacea/ and /Gila robusta/, decreased since the river was last surveyed (1964-68). A combination of factors likely account for this: habitat modification, poor water quality, and the presence of nonnative fishes.

76-001497 Dodswell, M. J. FURTHER NEW LOCALITIES FOR CERTAIN COLDWATER FISHES IN EASTERN ONTARIO AND WESTERN QUEBEC. Can. Field-Nat. 89 (4): 447-450. Oct.-Dec. 1975. SFA 21(4)

[Huntsman Mar. Lab., St. Andrews, NB, Canada] The fishes /Cottus ricei/, /Pungitius pungitius/, and /Percopsis omiscomaycus/ are reported in 36 new localities in eastern Canada. A total of 235 localities are now known for these fishes in fresh waters of eastern Ontario and western Quebec. The smelt, /Osmerus mordax/, is reported from 17 new localities in the Gatineau River Valley, Quebec. These new locality records indicate further that the dispersal of these fishes is closely associated with the maximum extent of the large, interconnected, post-Wisconsin glacial lakes, their outlet channels, and areas inundated by postglacial marine waters.

76-001498 Post, A. ERGEBNISSE DER FORSCHUNGSREISEN DES FFS "WALTHER HERWIG" NACH SUEDAMERIKA. XLII. /DIRETMUS/ JOHNSON, 1863 (BERYCIFORMES, BERYCOIDEI, DIRETMIDAE). 2. MORPHOLOGIE, NTWICKLUNG, VERBREITUNG. [RESULTS OF THE RESEARCH CRUISES OF FRV "WALTHER HEWIG" TO SOUTH AMERICA. XLII. /DIRETMUS/ JOHNSON, 1863 (BERYCIFORMES, BERYCOIDEI, DIRETMIDAE) 2. MORPHOLOGY, ONTOGENY, DISTRIBUTION.] Arch. Fischereiwiss. 26 (2/3): 87-114. Feb. 1976. In German with English summ. SFA 21(4)

[Inst. Seefisch. Bundesforschungsanst. Fisch., Hamburg, West Germany] The Berciforme fish-family Diretmidae actually is represented by two species, /D. argenteus/ Johnson, 1863 and /D. pauciradiatus/ Woods, 1973. Large series of specimens from both species were examined by the author and the results are dealed with in the present paper.

76-001499 Gilhen, J.; Gruchy, C. G.; McAllister, D. E. THE SHEEPSHEAD, /ARCHOSARGUS PROBATOCEPHALUS/, AND THE FEATHER BLENNY, /HYPSOBLENNIUS HENTZI/, TWO ADDITIONS TO THE CANADIAN ATLANTIC ICHTHYOFAUNA. Can. Field-Nat. 90 (1): 42-46. Jan.-Mar. 1976. SFA 21(4)

[Nova Scotia Mus., 1747 Summer St., Halifax, NS, Canada] The sheepshead, /Archosargus probatocephalus/, (Family Sparidae) is verifiably recorded from Canada for the first time. The family Blenniidae is first recorded from Canada with two specimens of /Hypsoblennius hentzi/. It is believed that these specimens reached the Nova Scotia coast by means of disjunct eddies of the Gulf Stream.

76-001500 Holcik, J. ZOZNAM BEZCELUSTNYCH A RYB SLOVENSKA. [LIST OF LAMPREYS AND FISHES OF SLOVAKIA.] Biologia (Bratisl.) 31 (8): 641-647. 1976. In Czech with English summ. SFA 21(4)

[Lab. Rybarstva Hydrobiol., Bratislava, Czechoslovakia] From the water bodies of Slovakia (Eastern part of Czechoslovakea, basins of the rivers Danube and Vistula) there were recorded 3 species of lampreys belonging to 2 genera, 1 family and 1 order and 76 species of fish which are members of 50 genera, 17 families and 8 orders. Nowadays (1975) only 73 species live in Slovakia due to extinction of /Huso huso/, /Acipenser nudiventris/, /A. stellatus/ and /Salmo salar/, as well as the sea trout--/Salmo trutta/ m. /trutta/. On the other side 17 species of fish were intentionally or incidentally introduced, or immigrated here from adjacent countries. From these 6 species originated from Eastern Asia, 5 from North America, 3 from Central America and 3 from other watersheds of Europe.--From abstr.

76-001501 Jandebeur, T. S. FISH SPECIES DIVERSITY, OCCURRENCE AND ABUNDANCE IN THE NORTH RIVER DRAINAGE SYSTEM OF ALABAMA. Ph. D. dissertation, Univ. Ala. 196p. 1975. From Diss. Abstr. Int. B Sci. Eng. 37(1), 1976. SFA 21(4)

76-001502 Kelso, D. P.; Bright, C. F. PRELIMINARY STUDIES ON THE DISTRIBUTION OF THE ICHTHYOFAUNA OF FAIRFAX COUNTY, VIRGINIA. Va. J. Sci. 27 (2): 46. 1976. Abstract only. SFA 21(4)

[Dep. Biol., George Mason Univ., Fairfax, VA 22030] The fish fauna of Fairfax County, Va. is being sampled as part of the establishment of environmental baseline information prior to development of a storm water management program. Sampling has been done at 119 sites with two 1/4 inch mesh seines, one 20 feet long with a 4 foot square bag and the other 10 feet long without a bag. The major factor affecting the distribution of a species is the physiographic separation between the Coastal Plain and the Piedmont. A second major factor is the effect of urbanization and highway construction in the stream watershed. This effect varies with each species and with the magnitude of the alteration. Thus, while many species, such as /Rhinichthys atratulus/, are widespread in their distribution, others such as /Salvelinus fontinalis/, are restricted to small areas. Comparison of recent collections with ones made in the early 1900's reveals that the ichthyofauna of all the sampled streams has changed, most often with a loss of species in recent times. For example, /Campostoma anomalum/ is no longer found in Fairfax County.

76-001503 Krefft, G. ERGEBNISSE DER FORSCHUNGSREISEN DES FFS "WALTHER HERWIG" NACH SUEDAMERIKA. XLI. FISCHE DER NORDNUNG BERYCIFORMES AUS DEM SUEDWESTATLANTIK. [RESULTS OF THE RESEARCH CRUISES OF FRV "WALTHER HERWIG" TO SOUTH AMERICA XLI. FISHES OF THE ORDER BERYCIFORMES FROM THE WESTERN SOUTH ATLANTIC.] Arch. Fischereiwiss. 26 (2/3): 65-86. Feb. 1976. In German with English summ. SFA 21(4)

[Inst. Seefisch. Bundesforschungsanst. Fisch., Hamburg, West Germany] Groundfish surveys off southern Brazil, Uruguay and Argentina carried out by FRV "Walther Herwig" during the winter months 1966 and in summer 1968 revealed the existence of 6 species of the order Beryciformes in the area concerned. /Polymixia lowei/ Guenther is by far the most common beryciform species. /Beryx decadactylus/ Cuvier is a very rare visitor to the western South Atlantic. /Beryx splendens/ Lowe is much more common in these waters than its congener, although never reported from the western South Atlantic heretofore. /Gephyroberyx darwini/ (Johnson), widely distributed in the warmer parts of all three oceans, is reported here for the first time from off southern Brazil. The recently (1973) described /Hoplostethus occidentalis/ Woods, heretofore known from the western North Atlantic only, occurs in the area investigated also.--From abstr.

76-001504 Molles, M. C., Jr. FISH SPECIES DIVERSITY ON MODEL AND NATURAL PATCH REEFS: EXPERIMENTAL INSULAR BIOGEOGRAPHY. Ph. D. dissertation, Univ. Ariz. 191p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(2), 1976. SFA 21(4)

Virtually no positive relationship was found between reef heterogeneity (interspace size diversity) and fish species diversity or richness on either model or natural patch reefs. Interspace size diversity had no significant effects on the species composition of fish communities on the model patch reefs. A slightly higher mean number of individuals was recorded on small interspace model reefs. Significant positive correlations were found between reef area and fish species richness on natural patch reefs for late spring and midsummer censuses. Significant positive correlations between reef height and fish species richness were found for midsummer censuses. The combination of reef height and area were consistent predictors of fish species diversity on natural patch reefs. The vertical distributions of selected fish species on the model patch reefs support the conclusion that vertical zonation is a means of resource partitioning in patch reef fish communities. A negative correlation was found between reef isolation and fish species richness on natural patch reefs in most of the cases examined. Significant seasonal fluctuations in numbers of individuals and species on the model patch reefs were observed. Fish species diversity on the model patch reefs was subject to less seasonal fluctuation. A similar pattern of fluctuations in these parameters was observed on the natural patch reefs. Season had more of an effect on the structure of fish communities on the model patch reefs than did succession. Immigration and local extinction of fish species occurred on the model patch reefs throughout the study. The relationship between rates of immigration and extinction and the number of fish species on the model patch reefs were similar to the predictions of the MacArthur-Wilson equilibrium model of insular zoogeography during the summer months of the study when species turnover was highest.--From abstr.

76-001505 Peden, A. E. FIRST RECORDS OF THE NOTACANTH FISH, /NOTACANTHUS CHEMNITZI/ BLOCH, FROM THE NORTHEASTERN PACIFIC. Calif. Fish Game 62 (4): 304-305. Oct. 1976. SFA 21(4).
[Mar. Biol., Div., British Columbia Prov. Mus., Victoria, BC, Canada]

76-001506 Rubec, P. J. FISH DISTRIBUTION IN GATINEAU PARK, QUEBEC, IN RELATION TO POSTGLACIAL DISPERSAL, MAN'S INFLUENCE, AND EUTROPHICATION. Can. Field-Nat. 89 (4): 389-399. Oct.-Dec. 1975. SFA 21(4)
[Dep. Biol., Texas A&M Univ., College Station, TX 77843] Postglacial freshwater and marine inundations have affected the distribution of fishes in Gatineau Park. Glacial Lake Frontenac allowed a cold-water fish fauna to enter higher alitude lakes. These were isolated by the Champlain Sea which also brought euryhaline species to lakes at medium elevation. Warm-water fishes from the Ottawa River were blocked from entering higher Gatineau Park lakes by isostatic rebound. More species were able to enter the Lac Lapeche drainage than the Meach-Philippe drainage. During the last hundred years, a general decline in abundance of lake trout (/Salvelinus namaycush/), brook trout (/Salvelinus fontinalis/), cisco (/Coregonus artedii/), and lake whitefish (/Coregonus clupeaformis/) has occurred, probably abetted by commercial fishing, poaching, and angling. Both smallmouth bass (/Micropterus dolomieui/) and brook trout prey on minnows which are scarce in lakes where bass were introduced. Low oxygen levels noted in the hypolimnia of most Gatineau Park lakes is thought to limit the coregonids and salmonids. An attempt has been made to replace those fish species that have disappeared.

76-001507 Sisk, M. E.; Webb, D. H. DISTRIBUTION AND HABITAT PREFERENCE OF /ETHEOSTOMA HISTRIO/ IN KENTUCKY. Trans. Ky. Acad. Sci. 37 (1-2): 33-34. Mar. 1976. SFA 21(4)
[Hunter Hancock Biol. Stn., Murray State Univ., Murray, KY 42071] /Etheostoma histrio/ has been taken from 5 locations in Kentucky, all within coastal plain streams. The species preferred deep riffle-detritus habitats in 3 of those streams and may soon be exterpated from those waters.

ABUNDANCE, FACTORS OF; SURVIVAL AND MORTALITY

76-001508 Cloern, J. E. THE SURVIVAL OF COHO SALMON (/ONCORHYNCHUS KISUTCH/) EGGS IN TWO WISCONSIN TRIBUTARIES OF LAKE MICHIGAN. Am. Midl. Nat. 96 (2): 451-461. Oct. 1976. SFA 21(4)
[Dep. Zool., Wash. State Univ., Pullman 99163] Natural reproduction of coho salmon (/Oncorhynchus kisutch/) in two Wisconsin tributaries of Lake Michigan is limited by an unusually high mortality of eggs and preemergent embryos. Of approximately 1800 coho salmon eggs planted in six study redds within Fischer Creek, none survived to hatching. The 1500 eggs planted in five study redds within Little Scarboro Creek produced 21 sac fry. The bottom materials of both streams are comprised of at least 15 percent (by volume) particles smaller than 0.84 mm in diam. Streambed gravels containing this quantity of sand, silt and clay do not allow for intragravel water of sufficient dissolved oxygen concentration or velocity to meet the oxygen requirements of developing salmon eggs. Water surrounding eggs planted in Fischer Creek and Little Scarboro Creek had mean dissolved oxygen concentrations of 3.96 and 6.22 mg/liter, respectively. The extremely low mean (2.83 C and 2.67 C) water temperatures of Fischer Creek and

76-001508 CONTINUED
Little Scarboro Creek were an added cause of egg loss. In response to low temperature, planted eggs hatched after a prolonged development period of approximately 145 days. Gravel shifts caused by variable stream flow in Fischer Creek may also be responsible for killing naturally deposited eggs there.--From abstr.

76-001509 Hager, R. C.; Noble, R. E. RELATION OF SIZE AT RELEASE OF HATCHERY-REARED COHO SALMON TO AGE, SIZE, AND SEX COMPOSITION OF RETURNING ADULTS. Prog. Fish-Cult. 38 (3): 144-147. July 1976. SFA 21(4)

[Wash. Dep. Fish., Olympia 98504] Yearling hatchery coho salmon (/Oncorhynchus kisutch/) were hand-graded into five groups of significantly different mean lengths. These groups were tagged with coded-wire. Mature 2- or 3-yr-old fish were later recovered at the hatchery. Within the yearling population, males tended to be larger than females; thus the proportion of males increased within the five groups with mean size. The proportion of males within each group returning as 2-yr-olds increased with mean release length of the group. Marine survival increased with mean size at release. The size (weight and length) of returning adults was about the same for males and females, but larger size at time of release was generally associated with larger size at return.

76-001510 Koski, K. V. THE SURVIVAL AND FITNESS OF TWO STOCKS OF CHUM SALMON (/ONCORHYNCHUS KETA/) FROM EGG DEPOSITION TO EMERGENCE IN A CONTROLLED-STREAM ENVIRONMENT AT BIG BEEF CREEK. Ph. D. dissertation, Univ. Wash. 230p. 1975. From Diss. Abstr. Int. B Sci. Eng. 37(2), 1976. SFA 21(4)

A controlled-flow stream channel 183 m long x 3 m wide was designed and built at the University of Washington's Big Beef Creek Fish Research Station in order that specific variables important in the reproduction of chum salmon (/Oncorhynchus keta/) could be manipulated and tested. An array of ecological adaptations was disclosed which allowed for the continuity of the genetic differences between the early and late stocks of chum salmon in Big Beef Creek. The adaptations in the adult chums included the time of spawning, size and age of the spawners, fecundity, and egg size; adaptations in the emergent fry included timing of emergence, stage of development, and size and robustness. Criteria for describing fry fitness were based on the preceding adaptations of the emergent fry. Equations were developed which described the effects of low concentrations of dissolved oxygen and increased levels of fine sediment on survival to emergence and fitness of chum salmon fry. A quantitative estimate of the effects of increased sediment indicated that survival to emergence decreased 1.26 percent for each 1.0 percent increment in sand. A decrease in fry fitness was directly related to low dissolved oxygen and high percentages of sand in the spawning gravel. A selective mortality against fry of a larger size was also suggested in gravel containing high amounts of sand. A reduction in fry fitness may have pronouced effects on survival following emergence. Much of the observed variability in marine survival may be accounted for by a knowledge of the rate of survival to emergence and fry fitness.--From abstr.

76-001511 Kuznetsov, V. A. ENVIRONMENTAL FACTORS AND INDICATORS OF ABUNDANCE OF THE YOUNG OF SOME FRESHWATER FISHES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 400-408. 1975. SFA 21(4)
[Dep. Vert. Zool., Kazan Univ., Kazan, USSR] Consideration is given to the correlation of indicators of the abundance of juvenile bream, roach, ide, asp, white bream, pike-perch and perch in periods of different water-level, temperature and wind regimes. Underyearlings keep to the inshore areas in the summer and yearlings keep to them in the spring, and these factors do not have a significant influence on records of their numbers, except for juvenile pike-perch. This is related both to specific features of the alteration in the factors under consideration in the years concerned and to the particular characteristics of the body of water. The distribution of bream underyearlings in the autumn is related to water temperature and to a lesser extent to water level.

76-001512 Latif, A. F. A.; Khallaf, E. S. A. MORTALITY RATES OF /LATES NILOTICUS/, L. IN LAKE NASSER. Hydrobiologia 50 (1): 27-32. July 1976. SFA 21(4)
[Lake Nasser Dev. Cent. Aswan, Aswan, United Arab Republic] Landings of /Lates niloticus/ from Lake Nasser belonged to age groups I-VII, with II-III predominent. Mortality rate, as computed by two different methods, ranges around 75 percent. Turbid flood water did not reach Lake Nasser in 1972, and this fact may be responsible for the decline in the commercial catch from 1972 to 1973.

76-001513 Primbs, E. R. J.; Platts, W. S. COLONIZATION OF THE SOUTH FORK OF THE SALMON RIVER BY THE COLUMBIA SCULPIN (/COTTUS HUBBSI/). J. Idaho Acad. Sci. 12 (1): 47-49. 1976. SFA 21(4)
[Intermountain Forest Range Exp. Stn., 316 E. Myrtle, Boise, ID 83706] Sampling of the fish populations on the South Fork of the Salmon River, probably Idaho's most productive stream for Chinook salmon and Steelhead trout, disclosed the presence of a flourishing colony of sculpins, identified as the Columbia species (/Cottus hubbsi/). Work is cited that has demonstrated that the sculpin is either a notorious predator of salmonid fry and/or a serious competitor with salmonid fingerlings for the available stream forage. In view of the very successful inhabitation of the South Fork by this predacious fish, it is suggested that predator and competitor control is indicated.

76-001514 Swenson, W. A.; Matson, M. L. INFLUENCE OF TURBIDITY ON SURVIVAL, GROWTH, AND DISTRIBUTION OF LARVAL LAKE HERRING (/COREGONUS ARTEDII/). Trans. Am. Fish. Soc. 105 (4): 541-545. July 1976. SFA 21(4).
[Dep. Biol. Cent. Lake Superior Environ. Stud., Univ. Wis.-Superior, Superior 54880] Influence of red-clay turbidity on survival, growth, and distribution of larval lake herring, /Coregonus artedii/, was measured by holding larvae for 62 days at 9 levels of suspended solids varying from 0 to 48 FTU (1 to 28 ppm). Test concentrations included the normal turbidity range of the red-clay area in western Lake Superior. The bioassay was conducted in a continuous-flow system using chambers designed to elicit normal behavioral responses to turbidity and light. Growth and survival were not influenced at the range of concentrations studied. Larvae in the higher suspensions were distributed closer to the surface of the test chambers, a condition which may indirectly influence survival in Lake Superior.

IDENTIFICATION, KEYS, CLASSIFICATION

76-001515 Andrews, A. P. A REVISION OF THE FAMILY GALAXIIDAE (PISCES) IN TASMANIA. Aust. J. Mar. Freshwater Res. 27 (2): 297-349. July 1976. SFA 21(4).

[Tasmanian Mus., G.P.O. Box 1164 M, Hobart, Tasmania 7001, Australia] Nine species of the genus /Galaxias/ and one species of the genus /Paragalaxias/ are found to be represented in Tasmania. The taxonomy, meristic and morphometric variation of each species is examined and data on the distribution, life history and ecology are presented together with references and synonymy. --From abstr.

76-001516 Bertelsen, E.; Pietsch, T. W. RESULTS OF THE RESEARCH CRUISES OF FRV "WALTHER HERWIG" TO SOUTH AMERICA. XXXVIII. OSTEOLOGY AND RELATIONSHIPS OF THE CERATIOID ANGLERFISH GENUS /SPINIPHRYNE/ (FAMILY ONEIRODIDAE). Arch. Fischereiwiss. 26 (1): 1-11. Aug. 1975. In English with German summ. SFA 21(4)

[Zool. Mus., Univ. Copenhagen, Denmark] The ceratioid anglerfish genus /Spiniphryne/ is diagnosed and described osteologically on the basis of new material recently collected from the eastern tropical Atlantic Ocean. Although, previously associated with the superficially similar genus /Centrophryne/, family Centrophrynidae, the closest relative of /Spiniphryne/ appears to be /Oneirodes/ of the family Oneirodidae. On the basis of overall similarity and shared derived character states, /Spiniphryne/ is the least derived oneirodid, most like the ancestral stock which gave rise to the family Oneirodidae.

76-001517 Fritzsche, R. A. A REVISION OF THE EASTERN PACIFIC SYNGNATHIDAE (PISCES: SYNGNATHIFORMES). Ph. D. dissertation, Univ. Calif. (San Diego) 197p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(4), 1976. SFA 21(4)

The eastern Pacific Syngnathidae comprises seventeen extant and three extinct species. Diagnostic characters for recognition of species and genera, including meristic and morphometric characters, and osteological features, are given. All species, both living and fossil, are diagnosed and described.--From abstr.

76-001518 Ivantsoff, W.; Glover, C. J. M. /CRATEROCEPHALUS DALHOUSIENSIS/ N.SP., A SEXUALLY DIMORPHIC FRESHWATER TELEOST (ATHERINIDAE) FROM SOUTH AUSTRALIA. Aust. Zool. 18 (2): 88-98. June 1974. SFA 21(4)

[Sch. Biol. Sci., Macquarie Univ., North Ryde, New South Wales, Australia 2113] /Craterocephalus dalhousiensis/ n.sp. is described from specimens collected in shallow water of artesian springs at Dalhousie Springs, South Australia and represents the first Australian record of a sexually dimorphic atherinid. /C. dalhousiensis/ appears to be closely related to /C. lacustris/ and /C. stercusmuscarum/ although meristic and morphometric differences make the new species readily distinguishable. A number of specimens of /C. dalhousiensis/ has been examined internally for gonad condition, gut content and presence of parasites. Water temperature, salinity and pH were measured at the time of collection and upper and lower thermal tolerances were also determined.

76-001519 Jones, B. C.; Geen, G. H. TAXONOMIC REEVALUATION OF THE SPINY DOGFISH (/SQUALUS ACANTHIAS/ L.) IN THE NORTHEASTERN PACIFIC OCEAN. J. Fish. Res. Board Can. 33 (11): 2500-2506. Nov. 1976. In English with French summ. SFA 21(4).

[Dep. Biol. Sci., Simon Fraser Univ., Burnaby, BC V5A 1S6, Canada] Morphometric ratios, vertebral counts, and electrophoretic analyses of spiny dogfish from east and west coasts of North America indicate that those in the northeastern Pacific Ocean comprise one of several discontinuous stocks of the cosmopolitan species /Squalus acanthias/ L. Though the individual stocks exhibit statistically significant differences in meristic and biochemical characteristics, available data do not support subspecific status for any of the groups around the Americas. The inadequacy of certain morphometric data to distinguish between /Squalus/ species is also discussed.

76-001520 Krefft, G.; Stehmann, M. ERGEBNISSE DER FORSCHUNGSREISEN DES FFS "WALTHER HERWIG" NACH SUEDAMERIKA. XXXVI. ZWEI WEITERE NEUE ROCHENARTEN AUS DEM SUEDWESTATLANTIK: /RAJA (DIPTURUS) LEPTOCAUDA/ UND /RAJA (DIPTURUS) TRACHYDERMA/ SPEC. NOV. (CHONDRICHTHYES, BATOIDEI, RAJIDAE). [RESULTS OF THE RESEARCH CRUISES OF FRV "WALTHER HERWIG" TO SOUTH AMERICA XXXVI. TWO MORE SPECIES OF SKATES FROM THE SOUTHERN WEST ATLANTIC, NEW TO SCIENCE: /RAJA (DIPTURUS) LEPTOCAUDA/ AND /RAJA (DIPTURUS) TRACHYDERMA/ N. SPP. (CHONDRICHTHYES, BATOIDEI, RAJIDAE).] Arch. Fischereiwiss. 26 (3): 77-97. Apr. 1975. In German with English summ. SFA 21(4)

[Inst. Seefisch. Bundesforschungsanst. Fisch., Hamburg, West Germany] Two new skate species from the southern West Atlantic Ocean, /Raja (Dipturus) leptocauda/ and /Raja (Dipturus) trachyderma/, are described. Both species are represented by their respective holotype only, collected during the cruises of R/V "Walther Herwig" to South America during 1968 and 1971. Both of them fall into the subgenus /Dipturus/ Rafinesque, 1810. The holotype of /R. leptocauda/ was taken on the deeper parts of the continental slope off southern Brazil, i.e. from the same area as the most recently described /R. sadowskii/, that of /R. trachyderma/ on the shelf off sourthern Argentina, although its characters obviously are those of a deep-water skate rather. From a taxonomic point of view skates of the subgenus /Dipturus/ form a notoriously difficult group due to the great uniformity of their morphological characters. Therefore, these two specimens had to be compared especially carefully with quite a number of /Dipturus/ species from all the world over. This comparison resulted--with some reluctance--in the erection of two new taxa.

76-001521 Mayer, G. F. RESULTS OF THE RESEARCH CRUISES OF FRV "WALTHER HERWIG" TO SOUTH AMERICA. XXXIX. THE EPIGONINE FAUNA OF THE SOUTH ATLANTIC, WITH KEY TO THE GENERA AND A REDESCRIPTION OF /ROSENBLATTIA ROBUSTA/ MEAD AND DE FALLA. Arch. Fischereiwiss. 26 (1): 13-28. Aug. 1975. In English with German summ. SFA 21(4)

[Dep. Mar. Sci., Univ. South Fla., St. Petersburg] Three species of epigoninae were taken in the South Atlantic by recent cruises of the FRV "Walther Herwig". /Epigonus telescopus/ and /E. robustus/ are deep-dwelling slope forms. The former has a bipolar distribution but is best known from the northeast Atlantic. The latter is endemic to the Subtropical Convergence region. /Rosenblattia robusta/ is a subantarctic mid-water form found in association with Antarctic Intermediate Water. A detailed redescription of /R. robusta/ accompanies analyses of its distribution and ontogeny. Inaccuracies in the original description pertaining to dorsal fin counts, opercular ornamentation and the interorbital region are corrected and a teratological specimen is described. A key to the genera of Epigoninae is also provided.

76-001522 Osipov, V. G. DISTRIBUTION OF SAURY (/SCOMBERESOX SAURUS/) FINGERLINGS IN THE VICINITY OF NEW ZEALAND. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 495-496. 1975. SFA 21(4)
[TINRO, Vladivostock, USSR]

76-001523 Pineda-Polo, F. H. THE TAXONOMY AND DISTRIBUTICN OF CHAETOGNATHS IN THE BIGHT OF PANAMA. Ph. D. dissertation, Stanford Univ. 393p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(2), 1976. SFA 21(4)

76-001524 Seshagiri Rao, B. V. A NEW SPECIES OF CLUPEID FISH, /ILISHA SIRISHAI/ FROM VISAKHAPATNAM, INDIA. Hydrobiologia 47 (3-4): 463-468. Dec. 1975. SFA 21(4)
[Dep. Zool., D.N.R. College, Bhimavaram 534202, India] A new species of clupeid fish, /Ilisha sirishai/ is described from Visakhapatnam, the Bay of Bengal, and compared with its close relatives /I. sladeni/ and /I. melastoma/.

76-001525 Trunov, I. A. NOTES ON FISHES OF THE SUBORDER STROMATEOIDEI FROM THE SOUTHEASTERN ATLANTIC. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 351-360. 1975. SFA 21(4)
[AtlantNIRO, Kaliningrad, USSR] The systematics of some species of the suborder Stromateoidei (mainly species of the genus /Cubiceps/) is reviewed. On the basis of a shcrt survey of separate groups of fishes and the material available, it is inferred that the systematics of stromateoid fishes requires further study and more precise definition at the lower systematic categories is necessary. Descriptions, comparative characteristics and the distribution of a number of species are presented.

76-001526 Wiley, E. O. III THE PHYLOGENY AND BIOGEOGRAPHY OF FOSSIL AND RECENT GARS (ACTINOPTERYGII: LEPISOSTEIDAE). Ph. D. dissertation, City Univ. N.Y. 340p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(1), 1976. SFA 21(4)
The relationships of gars to other actinopterygian fishes, the number of recognizable species of gars, the relationships of these species, and the biogeography of these species were investigated. Gars were found to comprise a monophyletic group. Gars are the sister-group of the Halecostomi (Amiidae plus Teleostei). These three taxa comprise another monophyletic group, the Neopterygii. The Neopterygii is the sister-group of the Chondrostei. These conclusions corroborate certain previous hypotheses and refute others. Sixteen species of gars are recognized. They are split equally among two genera, /Lepisosteus/ and /Atractosteus/. Track analysis of the biogeographic distributions of both genera indicates that both may have had a Pangean distribution and the minimum age for both genera is hypothesized 180 million years before present. Various tracks within each genus are discussed and relative levels of vicariance are hypothesized.--From abstr.

PARASITES AND DISEASES-GENERAL

76-001527 Arthur, J. R.; Margolis, L.; Arai, H. P. PARASITES OF FISHES OF AISHIHIK AND STEVENS LAKES, YUKON TERRITORY, AND POTENTIAL CONSEQUENCES OF THEIR INTERLAKE TRANSFER THROUGH A PROPOSED WATER DIVERSION FOR HYDROELECTRICAL PURPOSES. J. Fish. Res. Board Can. 33 (11): 2489-2499. Nov. 1976. In English with French summ. SFA 21(4).
[Dep. Environ., Fish Mar. Serv., Pac. Biol. Stn., Nanaimo, BC V9R 5K6, Canada] Forty-six species of parasites (14 Protozoa, 7 Monogenea, 7 Digenea, 8 Cestoda, 2 Acanthocephala, 4 Nematoda, 3 Copepoda, and 1 Hirudinoidea) were recovered from 383 specimens of 8 species of fishes collected from Aishihik and Stevens lakes, Yukon Territory, during the summer of 1973. Four species are reported for the first time from North America. Aspects of the systematics and distribution of several species are discussed and several new synonymies recognized. Substantial differences in the parasitic fauna of Aishihik and Stevens lakes are noted; the possible consequences of the introduction of species of potential economic and pathogenic importance into new areas as a result of the proposed diversion of Stevens Lake (Yukon River system) into Aishihik Lake (Alsek River system) are discussed. --From abstr.

76-001528 Fryer, J. L.; Rohovec, J. S.; Tebbit, G. L.; McMichael, J. S.; Pilcher, K. S. VACCINATION FOR CONTROL OF INFECTIOUS DISEASES IN PACIFIC SALMON. Fish Pathol. 10 (2): 155-164. 1976. SFA 21(4).
[Dep. Microbiol., Oreg. State Univ., Corvallis 97331] Experimental work done with the immunization against several fish pathogens is described. The agents studied included /Flexibacter columnaris/, /Aeronomas salmonicida/, /Vibrio anguillarum/ and Infectious Hematopoietic Necrosis Virus (IHNV). At the present, it appears that vaccines prepared against IHNV and bacterins against /V. anguillarum/ show potential for use in aquaculture.

76-001529 Ghittino, P. NOTE SULLA SITUAZIONE SANITARIA DELLE TROTICOLTURE ITALIANE NEL 1975. [GENERAL REMARKS ON THE HEALTH CONDITIONS OF ITALIAN TROUT FARMS DURING 1975.] Riv. It. Piscic. Ittiop. 11 (3): 89-93. July-Aug.-Sept. 1976. In Italian with English summ. SFA 21(4).
[Fish Disease Lab., Ist. Zoopr. Sper. Piem. Lig., Via Bologna, 148-10154 Torino, Italy] During the General Ordinary Convention of the Italian Fishfarmers Association held in Vicenza, Italy, on April 4, 1976, the speaker commented the health situation of Italian trout farms in 1975. According to the diagnostic survey performed by the Fish Disease Laboratory of Torino, the principal diseases affecting trout culture in the country were, in order of importance, /Viral Haemorrhagic Septicaemia/ (VHS), /Furunculosis/ (F), Red Mouth (RM)/, /Vibriosis (V)/, Gill Disease (GD)/, external parasitosis (due to /Costia necatrix/, /Ichthyophthirius multifiliis/, /Gyrodactylus elegans/), internal parasitosis (Whirling disease (WD)), due to /Myxosoma cerebralis/, and /Liver Lipoid Degeneration (LLD)/. The speaker stressed the VHS eradication program he suggested in Italy (a voluntary stamping out) and announced an international agreement to investigate the possibility of inducing resistance against VHS in trout farms. He emphasized also the unexpected outbreaks of trout diseases which in the past were serious, but they were controlled by management methods, such as WD and LLD. This recrudescence may be related to poor conduction in trout fingerling keeping and in trout feeding.

76-001530 Miller, R. W.; Chapman, W. R. /EPISTYLIS/ AND /AEROMONAS HYDROPHILA/ INFECTIONS IN FISHES FROM NORTH CAROLINA RESERVOIRS. Prog. Fish-Cult. 38 (3): 165-168. July 1976. SFA 21(4)
[Div. Fish. Wildl., Edward Tatnall Bldg., Dover, DE 19901] Fish samples taken by electofishing and in gill or trammel nets in the fall of 1973 revealed that the ciliated protozoan, /Epistylis/, was the primary cause of lesions found on 15 species of fish in the Yadkin and Catawba River reservoir chains in North Carolina. The bacterium, /Aeromonas hydrophila/, was isolated from the same external lesions occupied by /Epistylis/ in 11 of 12 fish examined bateriologically. /Epistylis/ colonies were noted on fish in four of five Yadkin River reservoirs and in all of six Catawba River reservoirs. The parasite was particularly common on white bass (/Morone chrysops/), white perch (/Morone americana/), striped bass (/Morone saxatilis/), and largemouth bass (/Micropterus salmoides/). A fish kill at Badin Lake in the Yadkin chain totaling an estimated 37,500 fish was attributed to the combined effects of /Epistylis/ and /Aeromonas hydrophila/.

BACTERIAL DISEASES

76-001531 Afanas'yev, V. I.; Slyn'ko, L. I.; Kolot, G. S. FEATURES OF ELECTROLYTE METABOLISM IN HEALTHY CARP (/CYPRINUS CARPIC/) AND THOSE INFECTED WITH RED-SPOT DISEASE. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 514-518. 1975. SFA 21(4)
[KrasNIIRKh, Krasnodar, USSR] Potassium concentration in the blood plasma of the carp is increased, and sodium concentration decreased in the acute form of red-spot disease. Potassium content in the erythrocytes is decreased. Calcium is considerably reduced and magnesium increased in the blood of the fish. In the chronic form of red-spot disease a tendency emerges for the disturbances to the ionic composition of the electrolytes to be returned practically to normal values. The investigation of electrolyte metabolism following the artificial infection of fish shows that /A. punctata/ plays an important role in the pathogenesis of red-spot disease in carp. The indicators of electrolyte metabolism in carp suffering from red-spot disease may serve as an additional diagnostic test.--From concl.

76-001532 Hoskins, G. FUSOBACTERIA ASSOCIATED WITH BACTERIAL GILL DISEASE OF SALMON. Prog. Fish-Cult. 38 (3): 150-151. July 1976. SFA 21(4)
[Dep. Environ., Fish. Mar. Serv., Pac. Biol. Stn., Nanaimo, BC V9R 5K6, Canada] This note describes cases of gill disease, observed in fry of cultured Pacific salmon (/Oncorhynchus/ spp.), apparently caused by a bacterium which morphologically seems to belong to the genus /Fusobacterium/. Repeated attempts to cultivate the organism on laboratory media failed. However, the repeated finding of this organism on the gills of salmon fry with obvious signs of gill disease suggests that it is the causative agent.

76-001533 Young, C. L. THE HISTOPATHOLOGY OF BACTERIAL KIDNEY DISEASE IN THE KIDNEY OF BROOK TROUT (/SALVELINUS FONTINALIS/). Ph. D. dissertation, Georgetown Univ. 337p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(2), 1976. SFA 21(4)

PROTOZOAN DISEASES

76-001534 Bettencourt, J. S., Jr. A STUDY OF HEMATOZOA OF SOME MARINE FISHES OF NORTHERN NEW ENGLAND. Ph. D. dissertation, Univ. N.H. 166p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(2), 1976. SFA 21(4)

76-001535 Kozel, T. R. THE OCCURRENCE OF /ICHTHYOPHTHIRIUS MULTIFILIS/ (CILIATA: HYMENOSTOMATIDA) IN KENTUCKY WATERS. Trans. Ky. Acad. Sci. 37 (1-2): 41-44. Mar. 1976. SFA 21(4)
[Dep. Biol., Univ. Louisville, Louisville, KY 40208] This is the first report of /Ichthyophthirius multifilis/, parasitizing the blackstripe topminnow /Fundulus notatus/. Data indicating site preferences and intensities of infestation of the parasite on its host are based on the examination of 10 males and 6 females. The caudal fin, head, and upper body surface are implicated as the most heavily parasitized area on the host. Smaller fish were more heavily infested than larger fish. A brief history of the occurrence of /I. multifilis/ in Kentucky waters is also included along with its distribution in nearby states.

76-001536 Moser, M. /CERATOMYXA ANOPLOPOMA/ SP.N. (PROTOZOA, MYXOSPORIDA) FROM THE SABLEFISH, /ANOPLOPAMA FIMBRIA/. Can. J. Zool. 54 (8): 1405-1406. Aug. 1976. In English with French summ. SFA 21(4)
[Dep. Biol. Sci., Univ. Calif., Santa Barbara 93106] /Ceratomyxa anoplopoma/ sp.n. is described from the gallbladder of the sablefish, /Anoplopoma fimbria/, from off southern California.

76-001537 Moser, M.; Haldorson, L. /ZSCHOKKELLA EMBIOTOCIDIS/ SP.N. (PROTOZOA, MYXOSPORIDA) FROM CALIFORNIA PILE PERCH, /DAMALICHTHYS VACCA/, AND STRIPED PERCH, /EMBIOTOCA LATERALIS/. Can. J. Zool. 54 (8): 1403-1405. Aug. 1976. In English with French summ. SFA 21(4)
[Dep. Biol. Sci., Univ. Calif., Santa Barbara 93106] /Zschokkella embiotocidis/ sp.n. was found in the gallbladders of /Damalichthys vacca/ and /Embiotoca lateralis/ from Diablo Cove off central California.

VIRAL DISEASES

76-001538 Elazhary, M. A. S. Y.; Lagace, A.; Cousineau, G.; Roy, R. S.; Berthiaume, L.; Paulhus, P.; Frechette, J. L. OUTBREAK OF INFECTIOUS PANCREATIC NECROSIS IN YEARLING BROOK TROUT (/SALVELINUS FONTINALIS/). J. Fish. Res. Board Can. 33 (11): 2621-2625. Nov. 1976. In English with French summ. SFA 21(4).
[Dep. Pathol. Microbiol., Univ. Montreal, Saint-Hyacinthe, PQ J2S 7C6, Canada] Studies were conducted to determine the etiology of an epizootic disease occurring in fry and yearling brook trout (/Salvelinus fontinalis/); clinical signs, experimental infection, and pathological lesions suggested infectious pancreatic necrosis.

76-001538 CONTINUED
Electron microscopy and physicochemical characteristics were used to identify the virus isolated from sick trout as IPN virus. The isolates showed only partial antigenic similarity to the reference strain IPN VR(299). Increased susceptibility to IPN virus was observed in one genetic line of trout.

76-001539 Yamamoto, T.; Macdonald, R. D.; Gillespie, D. C.; Kelly, R. K. VIRUSES ASSOCIATED WITH LYMPHOCYSTIS DISEASE AND DERMAL SARCOMA OF WALLEYE (/STIZOSTEDION VITREUM VITREUM/). J. Fish. Res. Board Can. 33 (11): 2408-2419. Nov. 1976. In English with French summ. SFA 21(4)

[Dep. Microbiol., Univ. Alberta, Edmonton, AB T6G 2E9, Canada] Gross examination of a spawning run of walleye (/Stizostedion vitreum vitreum/) showed a large proportion of fish to have tumors on the body and fins that appeared to be characteristic of lymphocystis disease. Light and electron microscopic examination revealed the presence of two distinct tumor types. One was characteristic of lymphocystis, consisting of typical enlarged nonneoplastic cells surrounded by hyaline layers and containing many 260 nm diameter lymphocystis virus particles in the cytoplasm. The other tumor, referred to as a dermal sarcoma, consisted of a solid mass of normal-sized cells and contained in the cytoplasm large numbers of 135 nm diameter virus particles referred to as walleye dermal sarcoma (WDS) virus. The WDS virus was similar in appearance to the leukoviruses and, with its outer layer sectioned tangentially, exhibited symmetry like a member of a leukovirus group designated by Fenner as subgenus C.

OTHER DISEASES AND PARASITES

76-001540 Hinton, D. E.; Jones, R. T.; Herman, R. L. GLOMERULAR MESANGIAL FIBROSIS IN HATCHERY-REARED RAINBOW TROUT (/SALMO GAIRDNERI/). J. Fish. Res. Board Can. 33 (11): 2551-2559. Nov. 1976. In English with French summ. SFA 21(4).

[Dep. Pathol., Sch. Med., Univ. Md., Baltimore 21201] Light and electron microscopic studies were performed on tissues of hatchery-reared rainbow trout (/Salmo gairdneri/) having a disease of currently unknown etiology with external symptoms of severe edema which causes increased mortality rate. Comparison with unaffected trout tissues revealed loss of cellularity in glomerular tufts with a replacement of mesangial cells by connective tissue. Ultrastructural studies showed the material to be collagen and established the diagnosis of glomerular mesangial fibrosis. The glomerular lesion was associated with alterations in lining epithelium of proximal tubules and extensive debris within tubule lumens. The findings are compared to glomerular lesions in mammalian and amphibian kidney.

76-001541 Kabata, Z. EARLY STAGES OF SOME COPEPODS (CRUSTACEA) PARASITIC ON MARINE FISHES OF BRITISH COLUMBIA. J. Fish. Res. Board Can. 33 (11): 2507-2525. Nov. 1976. In English with French summ. SFA 21(4).

[Dep. Environ., Fish. Mar. Serv., Pac. Biol. Stn., Nanaimo, BC V9R 5K6, Canada] Detailed descriptions and illustrations are presented of the nauplii (the only, or the first nauplius stage) of /Bomolochus cuneatus/, /Holobomolochus spinulus/, /Chondracanthus gracilis/, /Ergasilus turgidus/, /Eudactylina similis/, /Pseudocharopinus dentatus/, and /Haemobaphes diceraus/, and the copepodid stages of /H. diceraus/, /P. dentatus/, and /Nectobrachia indivisa/. The naupliar morphology of /Ergasilus/ is similar to that of free-living Cyclopidae

76-001541 CONTINUED
but differs in significant details from that of supposedly related /Bomolochus/. The nauplii of peocilostome and siphonostome copepods are similar. The morphology of the free-living larval stages might offer valuable clues to intrafamilial relationships of Lernaeopodidae. Differences were observed between copepodids of two species of /Haemobaphes/.

76-001542 Malmberg, G. THE EXCRETORY SYSTEMS AND THE MARGINAL HOOKS AS A BASIS FOR THE SYSTEMATICS OF /GYRODACTYLUS/ (TREMATODA, MONOGENEA). Ark. Zool. 23 (1): 1-235. 1974. SFA 21(4).

76-001543 Nebeker, A. V.; Stevens, D. G.; Stroud, R. K. EFFECTS OF AIR-SUPERSATURATED WATER ON ADULT SOCKEYE SALMON (/ONCORHYNCHUS NERKA/). J. Fish. Res. Board Can. 33 (11)d 2629-2633. Nov. 1976. In English with French summ. SFA 21(4).
[U.S. EPA, West. Fish Toxicol. Stn., Corvallis, OR 97330] Adult sockeye salmon (/Oncorhynchus nerka/) were exposed to air-supersaturated water in the laboratory from July 8 to August 13, 1974, approximately the same time period that they are exposed to supersaturated water during their movement through the lower and middle sections of the Columbia River. The first mortality occurred after 77 h exposure at 120 percent saturation; 40 percent of the fish were dead after 127 h. At 115 percent saturation the first mortality occurred after 523 h (21 days) and 40 percent were dead after 835 h (35 days). No further mortality occurred at 120 or 115 percent. However, at 120 and 115 percent saturation, survivors exhibited many sublethal lesions such as hemorrhaging and emphysema (bubbles) in the mouth, on the gill arches, body surface, and fins, etc. No deaths or signs of gas bubble disease occurred in fish held at 110 percent saturation in water 2 ft (60 cm) deep. The lethal threshold was near 114 percent saturation.

76-001544 Olsen, T. /PODOCOTYLE ATOMON/ (TREMATODA, DIGENEA) IN /GOBIUS FLAVESCENS/ (PERCOMORPHI, GOBIIDAE). Sarsia 61: 55-58. Aug. 1976. SFA 21(4)
[Inst. Biol. Geol., Postboks 790, N-9001, Tromso, Norway] Of 555 /Gobius flavescens/ from western Norway, randomly selected from 3,000 specimens, 103 (18.6 percent) contained /Podocotyle atomon/ either in the stomach or the intestine or both.

76-001545 Rauck, G. STARKER BEFALL DER NORDSEESPROTTEN DURCH DEN PARASITEN /LERNAEENICUS SPRATTAE/ (SOVERBY) UND /L. ENCRASICHOLI/ (TURTON). [NORTH SEA SPRAT INFESTED WITH THE PARASITIC COPEPOD /LERNAEENICUS SPRATTAE/ (SOVERBY) AND /L. ENCRASICHOLI/ (TURTON).] Arch. Fischereiwiss. 26 (2/3): 151-153. Feb. 1976. In German with English summ. SFA 21(4)
[Inst. Kusten- Binnenfisch. Bundesforschungsanst. Fisch., Hamburg, West Germany] 65 North Sea sprat infested with the parasitic copepod /Lernaeenicus/ were caught in a shrimp beam trawl at 3. Sept. 1975 near the coast of the East Friesian Islands. The number of parasites per fish and their location at the host have been investigated. The sprats eye can be infested with up to 5 parasites. Both eyes are never infested since complete blindness would most probably lead to immediate death. A correlation between the number of parasites and fish length could not be found.

76-001546 Samuel, N.; Nickol, B. B.; Mayes, M. A. ACANTHOCEPHALA OF NEBRASKA FISHES. Am. Midl. Nat. 96 (2): 391-406. Oct. 1976. SFA 21(4)
[Sch. Life Sci., Univ. Nebr., Lincoln 68508] Between April 1971 and August 1974, 2425 fishes representing 17 families and 57 species were collected from 71 sites throughout Nebraska and examined for acanthocephalans. Two hundred eighty-two (11.6 percent) of the fishes were infected. Except for an incidental mention of /Tanaorhamphus longirostris/, there is no previously published report of Acanthocephala in Nebraska's fishes. Nine species are now known to occur. Fishes from Sandhills region in N-central Nebraska were the most heavily parasitized and /Neoechinorhynchus cylindratus/ was the most frequently encountered acanthocephalan.--From abstr.

76-001547 Sherwood, M. J.; Mearns, A. J. OCCURRENCE OF TUMOR-BEARING DOVER SOLE (/MICROSTOMUS PACIFICUS/) OFF POINT ARGUELLO, CALIFORNIA AND OFF BAJA CALIFORNIA, MEXICO. Trans. Am. Fish. Soc. 105 (4): 561-563. July 1976. SFA 21(4).
[South. Calif. Coastal Water Res. Proj., 1500 East Imperial Highway, El Segundo, CA 90245] Twelve Dover sole (/Microstomus pacificus/ Lockington) with epidermal tumors have been located in museum collections of specimens from coastal waters off central California and off Baja California, Mexico. Data from these specimens extend the known range of tumor-bearing flatfish south along the Pacific Coast of North America and document the occurrence of affected specimens in areas distant from sources of waste discharge.

76-001548 Stunkard, H. W. THE LIFE CYCLES, INTERMEDIATE HOSTS, AND LARVAL STAGES OF /RHIPIDOCOTYLE TRANSVERSALE/ CHANDLER, 1935 AND /RHIPIDOCOTYLE LINTONI/ HOPKINS, 1954: LIFE-CYCLES AND SYSTEMATICS OF BUCEPHALID TREMATODES. Biol. Bull. 150 (2): 294-317. Apr. 1976. SFA 21(4)
[Am. Mus. Nat. Hist., Central Park West at 79th St., New York, NY 10024]

76-001549 Wellings, S. R.; Alpers, C. E.; McCain, B. B.; Miller, B. S. FIN EROSION DISEASE OF STARRY FLOUNDER (/PLATICHTHYS STELLATUS/) AND ENGLISH SOLE (/PAROPHRYS VETULUS/) IN THE ESTUARY OF THE DUWAMISH RIVER, SEATTLE, WASHINGTON. J. Fish. Res. Board Can. 33 (11): 2577-2586. Nov. 1976. In English with French summ. SFA 21(4).
[Dep. Pathol., Sch. Med., Univ. Calif., Davis 95616] Fin erosion in the starry flounder (/Platichthys stellatus/) and English sole (/Parophrys vetulus/) of the Duwamish River, Washington, is characterized by ulcerating chronic inflammation and fibrosis with resorption of fin rays. The end result is deformation, shortening, and retraction of residual fin tissue with loss of functional surface. We suggest that the incidence of fin erosion in a particular population is related to an interaction between genetic constitution and multiple environmental variables, including a variety of chemical pollutants.

POLLUTION

76-001550 Adams, J. R. THE INFLUENCE OF THERMAL DISCHARGES ON THE DISTRIBUTION OF MACROFLORA AND FAUNA. HUMBOLDT BAY NUCLEAR POWER PLANT, CALIFORNIA. Ph. D. dissertation, Univ. Wash. 381p. 1975. From Diss. Abstr. Int. B Sci. Eng. 37(2), 1976. SFA 21(4)
Populations of benthic and epifaunal macro-organisms living in the area influenced by the thermal discharge of the steam-electric power plant at Humboldt Bay, California, were analyzed in 1971 and 1972 to determine if differences in distribution could be attributed to the effluent. A total of 103 species representing 1745 individuals were recovered in the benthic samples from the bay. Stepwise multiple regression compared the variations in benthic species diversity with median particle size, percent organic matter, water depth, and temperature increase above ambient. Water depth had a greater influence on species distribution than water temperatures. Benthic diversity was positively correlated with water depth and percent organic matter, and negatively correlated with temperature, for one sampling period, but no correlations occurred for two other periods. Water depth accounted for over 20 percent of the variation in diversity, while temperature accounted for less than 2 percent.--From abstr.

76-001551 Ahokas, J. T.; Karki, N. T.; Oikari, A.; Soivio, A. MIXED FUNCTION MONOOXYGENASE OF FISH AS AN INDICATOR OF POLLUTION OF AQUATIC ENVIRONMENT BY INDUSTRIAL EFFLUENT. Bull. Environ. Contam. Toxicol. 16 (3): 270-274. Sept. 1976. SFA 21(4)
[Dep. Pharmacol., Univ. Oulu, SF-90220 Oulu 22, Finland]

76-001552 Benson, W. W.; Webb, W.; Brock, D. W.; Gabica, J. MERCURY IN CATFISH AND BASS FROM THE SNAKE RIVER IN IDAHO. Bull. Environ. Contam. Toxicol. 15 (5): 564-567. May 1976. SFA 21(4)
[Dep. Health Welfare, Statehouse, Boise, ID 83720]

76-001553 Burton, D. T.; Richardson, L. B.; Margrey, S. L.; Abell, P. R. EFFECTS OF LOW DELTA T POWERPLANT TEMPERATURES ON ESTUARINE INVERTEBRATES. J. Water Pollut. Control Fed. 48 (10): 2259-2272. Oct. 1976. SFA 21(4).
[Acad. Nat. Sci. Phila., Benedict Estuarine Res. Lab., Benedict, MD]

76-001554 Cugurra, F.; Maura, G. MERCURY CONTENT IN SEVERAL SPECIES OF MARINE FISH. Bull. Environ. Contam. Toxicol. 15 (5): 568-573. May 1976. SFA 21(4)
[Univ. Inst. Pharmacol. Via Capo S. Chiara 5, Genova, Italy]

76-001555 Cumbie, P. M. MERCURY LEVELS IN GEORGIA OTTER, MINK AND FRESHWATER FISH. Bull. Environ. Contam. Toxicol. 14 (2): 193-196. Aug. 1975. SFA 21(4)
[Design Eng. Dep., Duke Power Co., P.O. Box 2178, Charlotte, NC 28242] The data reported here indicate that the presence of mercury in fish of relatively unpolluted Lower Coastal Plain streams results in accumulation of mercury by otter and mink which feed on these fish. Otter exhibit hair mercury levels which approach those at which symptoms of neurological disorders have been reported in humans suffering from mercurial poisoning. Subtle effects on behavior resulting from sublethal mercurialism could affect the reproduction

76-001555 CONTINUED
and survival of certain populations of otter or mink. Possible sublethal effects of environmental mercury or other pollutants at trace levels on native animal populations deserve further study, since such information would be useful in formulating sound policies regarding discharge of pollutants under varying circumstances. Additional investigation is needed to determine the relative contributions of natural and man-caused mercury inputs to mercury levels observed in native wildlife species.--From Concl.

76-001556 Deelstra, H.; Power, J. L.; Kenner, C. T. CHLORINATED HYDROCARBON RESIDUES IN THE FISH OF LAKE TANGANYIKA. Bull. Environ. Contam. Toxicol. 15 (6): 689-698. June 1976. SFA 21(4)
[Univ. Instelling Antwerpen, 2610 Wilrijk, Belgium]

76-001557 Ernst, W.; Goerke, H.; Eder, G.; Schaefer, R. G. RESIDUES OF CHLORINATED HYDROCARBONS IN MARINE ORGANISMS IN RELATION TO SIZE AND ECOLOGICAL PARAMETERS I. PCB, DDT, DDE, AND DDD IN FISHES AND MOLLUSCS FROM THE ENGLISH CHANNEL. Bull. Environ. Contam. Toxicol. 15 (1): 55-65. Jan. 1976. SFA 21(4)

76-001558 Hamilton, R. D. AQUATIC ENVIRONMENTAL QUALITY: TOXICOLOGY. J. Fish. Res. Board Can. 33 (11): 2671-2688. Nov. 1976. In English with French summ. SFA 21(4).
[Dep. Environ., Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB R3T 2N6, Canada] Canadian research and control activities regarding the impact of toxic chemicals on aquatic environments are reviewed. Evaluation of specific research programs or results is not treated but an attempt is made to raise and discuss issues common to the problems posed by the use of toxic chemicals.

76-001559 Harvey, H. H. AQUATIC ENVIRONMENTAL QUALITY: PROBLEMS AND PROPOSALS. J. Fish. Res. Board Can. 33 (11): 2634-2670. Nov. 1976. In English with French summ. SFA 21(4).
[Dep. Environ., Fish. Mar. Serv., Oceanogr. Br., Ottawa, ON K1A 0H3, Canada] An overview was prepared of research and monitoring of aquatic environmental quality by federal and provincial agencies, the university, and private sectors. The overall effort in Canada was found to be unbalanced. Areas of strength were monitoring of water quantity, chemical water quality, and fish physiology-toxicology. Areas of weakness were the use of organisms and the use of whole systems as indicators of environmental quality. The amount of innovation was modest, due in part to the underutilization of the university community. In some areas of monitoring, data interpretation lags seriously behind data collection. A number of constraints now exist to our understanding of the source, distribution, and life expectancy of toxic substances in our environment, and these are discussed in relation to mercury. Specific problems of aquatic environmental quality are discussed by economic sector.

76-001560 Huschenbeth, E.; Harms, U. ON THE ACCUMULATION OF ORGANOCHLORINE PESTICIDES, PCB AND CERTAIN HEAVY METALS IN FISH AND SHELLFISH FROM THAI COASTAL AND INLAND WATERS. Arch. Fischereiwiss. 26 (3): 109-122. Apr. 1975. In English with German summ. SFA 21(4)
[Inst. Kusten- Binnenfisch. Isotopenlab. Bundesforschungsanst. Fisch., Hamburg, West Germany] 819 samples of 27 genera of fish, 4 genera of crustaceans and 3 genera of molluscs were collected from 4 fishing areas off the Thai coast and from 3 inland areas and analysed as to their content of DDT, TDE, DDE, Lindane, Dieldrin and PCB. The

76-001560 CCNTINUED
greater portion of the samples was also analysed with special regard to its content of the metallic trace elements ccpper, zinc, cadmium, lead and mercury. As pesticides and PCBs are in general present only in order less than that of North Sea and comparable to the North Atlantic fish and the heavy metals are comparable to the North Sea and to fish from more distant waters there is nc immediate need for the development of an expensive monitoring program on the accumulation of these pollutants in Thai marine fish for the time being. It might be well sufficient to repeat this study after some time in order to be kept informed.

76-001561 Klemmer, H. W.; Unninayer, C. S.; Okubo, W. I. MERCURY CONTENT OF BIOTA IN COASTAL WATERS IN HAWAII. Bull. Environ. Contam. Toxicol. 15 (4): 454-457. Apr. 1976. SFA 21(4)
[Pac. Biomed. Res. Cent., Univ. Hawaii, Honolulu] A survey of mercury and pesticide residue content of biota collected from four coastal areas of Hawaii was undertaken as part of a multi-disciplinary project in Quality of Coastal Waters supported by the Sea Grant Program of the University of Hawaii. Information collected from this survey is presented for evidence of biological concentraticn of mercury and of any influence of agricultural or urban waste discharges on mercury concentrations in coastal biota.

76-001562 Kuehl, D. W.; Kopperman, H. L.; Veith, G. D.; Glass, G. E. ISOLATION AND IDENTIFICATION OF POLYCHLORINATED STYRENES IN GREAT LAKES FISH. Bull. Environ. Contam. Toxicol. 16 (2): 127-132. Aug. 1976. SFA 21(4)
[U.S. EPA, 6201 Congdon Blvd., Duluth, MN 55804] Octachlorostyrene was prepared by two independent synthetic routes, and GC retention time data as well as a mass spectrum of the standard were obtained. A comparison of these data with those observed for a component in fish from Lake Huron, Lake Ontario, and the lower Detroit River indicates that octachlorcstyrene is present in fish residues from these sources. In addition, mass spectral data indicated the presence of several hepta and hexachlorostyrene iscmers in these fish. Further studies should be concerned with quantification of OCS and evaluaticn of possible sources of these compcunds, such as impurities in products produced by exhaustive chlorination or as by-products in the electrolytic production of chlorine.--Summ.

76-001563 Mathis, B. J.; Kevern, N. R. DISTRIBUTION OF MERCURY, CADMIUM, LEAD AND THALLIUM IN A EUTROPHIC LAKE. Hydrobiologia 46 (2-3): 207-222. Mar. 1975. SFA 21(4)
[Dep. Biol., Bradley Univ., Peoria, IL 61606] Five species of fishes, twc species of aquatic macrophytes, zocplankton, migratory goose feces, water and sediments from a eutrophic lake were analyzed for mercury, cadmium, lead and thallium. Mercury was detected in fishes and sediments only while cadmium and lead were detected in all components. Thallium was detected only in sediments. Sediments in the lake act as a 'sink' for the four metals. Mercury in axial musculature of largemouth bass was highly correlated with length and weight. A high degree of correlation between other metals and weight and length of other species was not evident. The feces of migratory waterfowl had high concentrations of both cadmium and lead. In view of the large quantity of waterfowl feces deposited within the drainage basin, it is suggested that this avenue is cne of the major sources of contamination for the two metals and that fallout from airborne particulate matter is secondary. Fallout of airborne particulate matter may be the primary methcd by which mercury and thallium enter the lake although residual concentraions of the four metals in soil of

76-001563 CONTINUED
the drainage basin were not determined.

76-001564 Parejko, R.; Johnston, R.; Keller, R. CHLOROHYDROCARBONS IN LAKE SUPERIOR LAKE TROUT (/SALVELINUS NAMAYCUSH/). Bull. Environ. Contam. Toxicol. 14 (4): 480-488. Oct. 1975. SFA 21(4)
[Dep. Biol., North Mich. Univ., Marquette, MI 49855]

76-001565 Payne, J. F.; Penrose, W. R. INDUCTION OF ARYL HYDROCARBON (BENZO [A] PYRENE) HYDROXYLASE IN FISH BY PETROLEUM. Bull. Environ. Contam. Toxicol. 14 (1): 112-116. July 1975. SFA 21(4)
[Environ. Can., Fish. Mar. Serv., Biol. Stn., St. John's, NF A1C 1A1, Canada]

76-001566 Ratkowsky, D. A.; Dix, T. G.; Wilson, K. C. MERCURY IN FISH IN THE DERWENT ESTUARY, TASMANIA, AND ITS RELATION TO THE POSITION OF THE FISH IN THE FOOD CHAIN. Aust. J. Mar. Freshwater Res. 26 (2): 223-231. July 1975. SFA 21(4).
[Div. Math. Stat., CSIRO Tasmanian Reg. Lab., Hobart, Tas. 7000, Australia] Total mercury concentrations are reported for 258 individuals representing 16 species of finfish from the Derwent Estuary, Tasmania. Mercury concentrations in the muscle tissue varied between undetectable levels and a value of 2.0 mg/kg in one specimen of a species of shark. Irrespective of species, the area encompassing Ralphs Bay contained a higher percentage of fish with mercury concentrations in excess of the Tasmanian Food Regulation limit of 0.5 mg/kg than any other area of the Estuary. Ralphs Bay is the area in which oysters were found in a previous study to contain extraordinarily high concentrations of other heavy metals, particularly zinc, cadmium and copper. The fish's position in the food chain appeared to be an important factor determining its mercury content. Approximately 51 percent of individual fish of species whose diet consists predominantly of other fish had mercury concentrations in excess of 0.5 mg/kg. In contrast, 24 percent of invertebrate predators and only 7 percent of individuals of herbivorous habit had mercury concentrations in excess of 0.5 mg/kg.

76-001567 Reimer, A. A.; Reimer, R. D. TOTAL MERCURY IN SOME FISH AND SHELLFISH ALONG THE MEXICAN COAST. Bull. Environ. Contam. Toxicol. 14 (1): 105-111. July 1975. SFA 21(4)
[208 Life Sci. I, Pa. State Univ., University Park 16802]

76-001568 Shultz, C. D.; Crear, D.; Pearson, J. E.; Rivers, J. B.; Hylin, J. W. TOTAL AND ORGANIC MERCURY IN THE PACIFIC BLUE MARLIN. Bull. Environ. Contam. Toxicol. 15 (2): 230-234. Feb. 1976. SFA 21(4)
[Dep. Agric. Biochem., Univ. Hawaii, Honolulu 96822]

76-001569 Smith, E. C.; Berkes, F.; Spence, J. A. MERCURY LEVELS IN FISH IN THE LA GRANDE RIVER AREA, NORTHERN QUEBEC. Bull. Environ. Contam. Toxicol. 13 (6): 673-677. June 1975. SFA 21(4)
[Mar. Sci. Cent., McGill Univ., Montreal, PQ, Canada]

76-001570 Stockner, J. G.; Cliff, D. D. EFFECTS OF PULPMILL EFFLUENT ON PHYTOPLANKTON PRODUCTION IN COASTAL MARINE WATERS OF BRITISH COLUMBIA. J. Fish. Res. Board Can. 33 (11): 2433-2442. Nov. 1976. In English with French summ. SFA 21(4).

[Dep. Environ., Fish. Mar. Serv., Pac. Environ. Inst., West Vancouver, BC V7V 1N6, Canada] Phytoplankton production adjacent to two kraft pulpmills in Howe Sound, British Columbia, was considerably lower than daily rates at control stations removed from the zone of influence. Average daily production at the Port Mellon mill was 29 and 24 mg C/m²/day in 1973 and 1974, in contrast with 332 and 367, in respective years at the control. Less difference in production was seen between Woodfibre mill and its control, because this mill is situated in a more actively flushed location. Howe Sound studies showed little qualitative or quantitative difference between chlorophyll /a/ levels or phytoplankton assemblages among mill and control stations. /Skeletonema costatum/ and /Thalassiosira/ spp. were dominant phytoplankton species. Light attenuation and selective absorption of 400-500 nm wavelength light by kraft mill effluent was considered the major factor responsible for reduced production in the zone of influence. Axenic culture studies with marine phytoplankton showed that phytotoxicity occurs only at high effluent concentrations. Our laboratory experiments suggest that, given sufficient time, it is possible for phytoplankton to adapt to relatively high effluent concentrations, if pH remains normal.

76-001571 van Dyke, L. P.; Greeff, C. G.; Brink, J. J. TOTAL POPULATION DENSITY OF CRUSTACEA AND AQUATIC INSECTA AS AN INDICATOR OF FENTHION POLLUTION OF RIVER WATER. Bull. Environ. Contam. Toxicol. 14 (4): 426-431. Oct. 1975. SFA 21(4)

[Plant Prot. Res. Inst., Private Bag X134, Pretoria 0001, South Africa] The total population density was proved to be a sensitive indicator of fenthion pollution and can be used when no analytical facilitiles are available. Furthermore sampling for chemical analysis is usually limited in volume and frequency, whereas the Crustacea and aquatic Insecta populations are continually present to monitor pollution. It is also an inexpensive method compared to the use of sophisticated collection samplers or resins. The only prerequisite is, that the total population density before pollution must be known, and this can be established by long-term observations.--Concl.

76-001572 Wortham, K. E. THE EFFECTS OF POLLUTION ON THE BENTHIC MACROINVERTEBRATES OF BIG LICK CREEK, INDIANA. Ph.D. dissertation, Ball State Univ. 125p. 1974. From Diss. Abstr. Int. B Sci. Eng. 35(8), 1975. SFA 21(4).

Big Lick Creek, a tributary of the Mississinewa River, is located in east central Indiana and has a permanent length of about 32.2 km. Significant chemical and bacteriological conditions encountered in the stream below the sewage effluents of Dunkirk and Hartford City, Indiana were as follow: (1) dissolved oxygen minima of 2 ppm or less; (2) free carbon dioxide maxima in excess of 60 ppm; (3) increases in nutrients such as the various forms of nitrogen and phosphate; and (4) drastic increases in fecal coliform densities. Twenty-six species of benthic macroinvertebrates were collected during the study with marked reductions in the number of species occurring below the effluents. The average number of species occurring below these polluting effluents was 10.5 as compared to 22 farther downstream in recovery zones. Limiting and selective effects of organic pollution were indicated by the composition of the benthic community at each station. Tubificids, tolerant of excessive organic pollution and associated low dissolved oxygen levels, constituted more than 99 per cent of the benthic communities sampled below Dunkirk and Hartford City. A maximum

76-001572 CONTINUED
tubificid density of 13,050/m² was obtained below Hartford City. Samples taken from a recovery zone 14.8 km downstream from Dunkirk and a corresponding zone 10.1 km below Hartford City showed more diverse fauna. All species collected, in numbers sufficient to be considered, were members of an indicator association characteristic of organically enriched environments.-- From abstr.

76-001573 Yamanaka, S.; Ueda, K. HIGH ETHYLMERCURY IN RIVER FISH BY MAN-MADE POLLUTION. Bull. Environ. Contam. Toxicol. 14 (4): 409-414. Oct. 1975. SFA 21(4)
[Dep. Hygiene, Tokyo Dental Coll. 2-9-19, Misaki-cho, Chiyoda-ku, Tokyo, Japan] This survey of mercury contamination in the Jinzu River led to the following conclusions: 1) This was the first incident in which fish were found to be contaminated by ethylmercury from industrial waste water. 2) The river pollution could be detected and the suspected spots might be identified by analyzing the mercury level in river fish. 3) Alkyl mercury pollution continued in the fish for several years, even though the source of pollution was eliminated. 4) The pattern of mercury contamination in fish from a man-made source, as found in the Jinzu River, was different from that in fish contaminated by natural geological sources.--From results and discuss.

TOXICOLOGY; BIOASSAYS

76-001574 Adelman, I. R.; Smith, L. L., Jr.; Siesennop, G. D. CHRONIC TOXICITY OF GUTHION TO THE FATHEAD MINNOW (/PIMEPHALES PROMELAS/ RAFINESQUE). Bull. Environ. Contam. Toxicol. 15 (6): 726-733. June 1976. SFA 21(4)
[Dep. Entomol. Fish. Wildl., Univ. Minn., St. Paul 55108]

76-001575 Anderson, A. C.; Abdelghani, A. A.; Smith, P. M.; Mason, J. W.; Englande, A. J., Jr. THE ACUTE TOXICITY OF MSMA TO BLACK BASS (/MICROPTERUS DOLOMIEU/), CRAYFISH (/PROCAMBARUA SP./) AND CHANNEL CATFISH (/ICTALURUS LACUSTRIS/). Bull. Environ. Contam. Toxicol. 14 (3): 330-333. Sept. 1975. SFA 21(4)
[Dep. Environ. Health Sci., Tulane Univ., New Orleans, LA 70112] Fingerling black bass were found to be the most sensitive of the three species tested. Forty-eight hour and 96 hour TLM's of 1660 mg/l and 900 mg/l, respectively, were obtained indicating good tolerance on the part of the species to MSMA. Mixed species of red swamp and white river crayfish were slightly less sensitive to MSMA than black bass. The Median Lethal Threshold (TLM) at 48 hours was 5100 mg/l and at 96 hours 1100 mg/l. Differences in sensitivity from bass are small and the species could be considered similar in response to the compound. The channel catfish was the most tolerant of the three species tested. Forty-eight hour and 96 hour TLM's of 4700 mg/l and 3050 mg/l, respectively, were obtained indicating a roughly three fold increase in tolerance over black bass.--From Results and Discuss.

76-001576 Anees, M. A. ACUTE TOXICITY OF FOUR ORGANOPHOSPHORUS INSECTICIDES TO A FRESHWATER TELEOST /CHANNA PUNCTATUS/ (BLOCH). Pak. J. Zool. 7 (2): 135-141. 1975. SFA 21(4).

[Dep. Zool., Ind. Univ., Bloomington 47401] Static bioassays were carried out to determine the acute toxicity of four organophosphorus insecticides to a freshwater teleost /Channa punctatus/ (Bloch). 96-hour median tolerance limit (TLm) was in the following order; diazinon (0.455 ppm), malathion (0.920 ppm), methyl parathion (2.150 ppm), and dimethoate (20.500 ppm). Behavioural symptoms of acute intoxication in fish were similar to those reported to be appearing after inhibition of acetylcholinesterase by organophosphates. Mechanism of death by, and variations in species susceptibility to organophosphorus insecticides are discussed.

76-001577 Benoit, D. A.; Leonard, E. N.; Christensen, G. M.; Fiandt, J. T. TOXIC EFFECTS OF CADMIUM ON THREE GENERATIONS OF BROOK TROUT (/SALVELINUS FONTINALIS/). Trans. Am. Fish. Soc. 105 (4): 550-560. July 1976. SFA 21(4).

[U.S. EPA, Environ. Res. Lab., 6201 Congdon Blvd., Duluth, MN 55804] Three generations of brook trout (/Salvelinus fontinalis/) were exposed to several concentrations of total cadmium (0.06-6.4 ug Cd/liter). Significant numbers of first- and second-generation adult males died during spawning at 3.4 ug Cd/liter. This concentration also significantly retarded growth of juvenile second- and third-generation offspring. The maximum acceptable toxicant concentration (MATC) for brook trout exposed to cadmium in Lake Superior water (hardness 44 mg/liter as CaCO(3), pH 7-8) lies between 1.7 and 3.4 ug Cd/liter. Cadmium-residue analyses of kidney, liver, gill, gonad, spleen, muscle, and red blood cells from first- and second-generation trout indicated that kidney, liver, and gill tissue accumulated the greatest amounts of cadmium at each water exposure concentration. No significant increases in cadmium were measured in edible muscle at any of the cadmium water concentrations tested. Cadmium residues in kidney, liver, and gill tissue of fish from all exposure concentrations reached equilibrium (ug Cd/g tissue) in both first- and second-generation trout after 20 weeks. Cadmium loss from gill tissue of second-generation trout placed in control water for 12 weeks was rapid; however, no loss was detectable from the liver and kidney.

76-001578 Berry, C. R., Jr.; Schreck, C. B.; Van Horn, S. L. AQUATIC MACROINVERTEBRATE RESPONSE TO FIELD APPLICATION OF THE COMBINED HERBICIDES DIQUAT AND ENDOTHALL. Bull. Environ. Contam. Toxicol. 14 (3): 374-379. Sept. 1975. SFA 21(4)

[Dep. Fish. Wildl. Sci., VPI & SU, Blacksburg, VA 24061] The application of diquat and endothall mixture to Chickahominy Reservoir to control /Egeria/ did not directly harm invertebrate populations. The artificial substrate employed proved to be an economical and easily constructed means of monitoring macroinvertebrate responses /in situ/. The substrates provided "standard" unoccupied habitats for colonization and attracted fish food organisms normally associated with dense vegetation.--From results and discuss.

76-001579 Bills, T. D.; Hunn, J. B. CHANGES IN THE BLOOD CHEMISTRY OF COHO SALMON EXPOSED TO MALACHITE GREEN. Prog. Fish-Cult. 38 (4): 214-216. Oct. 1976. SFA 21(4).

[U.S. FWS, Fish Control Lab., La Crosse, WI 54601] Exposure of fed and fasted coho salmon (/Oncorhynchus kisutch/) to 0.1 mg/l of malachite green for 1 to 28 days had little effect on a number of the constituents of the blood of the salmon. The white blood cell count declined transiently during the first 4 days of exposure but returned to normal by day 7. Fasting for 28 days reduced the red blood cell count, hematocrit, and hemoglobin in the controls but not in the treated fish; apparently exposure to the chemical suppressed the symptoms of fasting. Malachite green increased K^+ levels in the plasma of both fed and fasted fish, but did not affect the concentrations of Na^+, Ca^{++}, Mg^{++}, or Cl^-. Histopathological examination showed no differences between exposed fish and controls, except that the kidney and spleen of the controls contained many more macrophages. In general, the exposed fish appeared to be healthier than the controls.

76-001580 Brocker, M. P. THE ECOLOGICAL EFFECTS OF THE USE OF DALAPON AND 2,4-D FOR DRAINAGE CHANNEL MANAGEMENT. I. FLORA AND CHEMISTRY. Arch. Hydrobiol. 78 (3): 396-412. Sept. 1976. SFA 21(4)

[Llysdinan Field Cent., U.W. I.S.T., Newbridge-on-Wye, Powys, Wales] A field experiment designed to compare directly the ecological effects of the use of herbicides for drainage channel maintenance and the conventional method of hand clearance was carried out at an experimental site in Essex, England. An autumn application of dalapon successfully controlled /Phragmites communis/ and an application of dalapon and 2,4-D in the subsequent spring restricted the growth of ditchbank vegetation. Changes in the flora following herbicide use are described and changes in natural and herbicide chemistry recorded. Estimates of the biomass and net productivity of macrophytes were made.

76-001581 Cairns, J., Jr.; van der Schalie, W. H.; Westlake, G. F. THE EFFECTS OF LAPSED TIME SINCE FEEDING UPON THE TOXICITY OF ZINC TO FISH. Bull. Environ. Contam. Toxicol. 13 (3): 269-274. Mar. 1975. SFA 21(4)

[Biol. Dep. Cent. Environ. Stud., VPI & SU, Blacksburg, VA 24061] Fish were fed for 25 minutes and at specific times after feeding (0, 1, 2, 4, 6, 12, 24, 72 hours) groups of 10 fish were placed into 18 liters of water containing a lethal concentration (100 mg/l) of zinc as ZnSO(4). Time until death was recorded for individual fish. A total of 420 fish (excluding controls) were exposed to zinc in the course of seven experimental runs. Statistical analysis revealed a slight but non-significant increase in survival time in the interval between feeding and exposure to zinc increased. These variations in survival time do not appear to be of sufficient magnitude to support the standard acute bioassay requirement that fish not be fed for 24 or 48 hours prior to their exposure to a toxicant.--From summ.

76-001582 Cairns, J., Jr.; Heath, A. G.; Parker, B. C. THE EFFECTS OF TEMPERATURE UPON THE TOXICITY OF CHEMICALS TO AQUATIC ORGANISMS. Hydrobiologia 47 (1): 135-171. July 1975. SFA 21(4)

[Dep. Biol. Cent. Environ. Stud., VPI & SU, Blacksburg, VA 24061] Although rather extensive bibliographies give the impression that there is a vast amount of literature on the effects of temperature on aquatic organisms, when one tries to apply this information to specific interactions, such as the effects of temperature changes on chemical toxicity to aquatic organisms, often very little of the evidence is applicable. Although the most useful information on this

76-001582 CONTINUED
relationship has been acquired in laboratory situations even this body of literature (which forms the bulk of this paper) is not adequate to make any scientifically justifiable generalizations. Field data on this relationship is almost non-existent and it is unlikely that much will become available unless specific studies are initiated which are directed toward this end. This is equally true of the laboratory information although it seems more likely that this will be generated as a spinoff from other research activities. In order to develop water quality management programs for steam-electric power plants one should understand the relationship between temperature and the response of aquatic organisms to toxic chemicals. Not only do some power plants discharge chlorine and other similar materials as well as heated waste water but those that discharge the latter only may be located near discharges of toxic chemicals. Since temperature and chemical stress to aquatic organisms are most commonly discussed independently we felt a paper covering this relationship would be useful.

76-001583 Canton, J. H.; Van Esch, G. J. THE SHORT-TERM TOXICITY OF SOME FEED ADDITIVES TO DIFFERENT FRESHWATER ORGANISMS. Bull. Environ. Contam. Toxicol. 15 (6): 720-725. June 1976. SFA 21(4)
[Natl. Inst. Public Health, P.O. Box 1, Bilthoven, The Netherlands] The short-term toxicity of 13 feed additives was determined to 4 freshwater organisms of different trophical levels: /Chlorella pyrenoidosa/, /Daphnia magna/, /Lebistes reticulatus/ and /Salmo gairdneri/. The most toxic (LC(EC)(50) less than 1 mg/l) were robenidine (to all tested organisms) and stenorol (to Daphnia); moderately toxic (1 less than LC(EC)(50) less than 10 mg/l) was pyrimethamine. Amprolium, ethopabate, furazolidone and zoalene proved to be little toxic (LC(EC)(50) greater than 10 mg/l); whereas buquinolate, carbadox, clopidol, decoquinate, grofas and sulfaquinoxaline were under the experimental conditions not toxic for the tested organisms.--From summ.

76-001584 Canton, J. H. THE TOXICITY OF BENOMYL, THIOPHANATE-METHYL, AND BCM TO FOUR FRESHWATER ORGANISMS. Bull. Environ. Contam. Toxicol. 16 (2): 214-218. Aug. 1976. SFA 21(4)
[Natl. Inst. Public Health, Lab. Toxicol., Bilthoven, The Netherlands] The 2-day studies with 3 fungicides, thiophanate-methyl proved to be the least toxic to all tested freshwater organisms. BCM was most toxic for Chlorella and Daphnia, while benomyl was the most toxic for the 2 test fishes. Based on the influence of BCM on the reproductive capacity of Daphnia, a provisional E.L. less than 16 ug BCM/l could be stated, but more research has to be done to confirm this provisional figure.--from concl.

76-001585 Chaiyarach, S.; Ratananun, V.; Harrel, R. C. ACUTE TOXICITY OF THE INSECTICIDES TOXAPHENE AND CARBARYL AND THE HERBICIDES PROPANIL AND MOLINATE TO FOUR SPECIES OF AQUATIC ORGANISMS. Bull. Environ. Contam. Toxicol. 14 (3): 281-284. Sept. 1975. SFA 21(4)
[Biol. Dep., Lamar Univ., Beaumont, TX 77710]

76-001586 Cock, G. H.; Moore, J. C.; Coppage, D. L. THE RELATIONSHIP OF MALATHION AND ITS METABOLITIES TO FISH POISONING. Bull. Environ. Contam. Toxicol. 16 (3): 283-290. Sept. 1976. SFA 21(4)
[U.S. EPA, Environ. Res. Lab., Sabine Island, Gulf Breeze, FL 32561] Periodic environmental monitoring by chemical analyses of sensitive fishes or water for malathion or malaoxon would not show poisoning caused by enzyme-bound metabolites because malathion and malaoxon are rapidly absorbed and metabolically altered in fish. Parent pesticide remaining in water is probably dispersed or altered. Our data indicate analysis for malathion monoacid in gut and measurement of brain acetylcholinesterase activity in fish from the natural environment are a practical measure of poisoning caused by malathion in sensitive fish. Measurable concentrations of parent compound need not be present, but acetylcholinesterase inhibition in brain must occur for fish to be poisoned.--From results and discuss.

76-001587 Doyle, M.; Koepp, S.; Klaunig, J. ACUTE TOXICOLOGICAL RESPONSE OF THE CRAYFISH (/ORCONECTES LIMOSUS/) TO MERCURY. Bull. Environ. Contam. Toxicol. 16 (4): 422-424. Oct. 1976. SFA 21(4)
[Biol. Dep., Montclair State Coll., Upper Montclair, NJ 07043]

76-001588 Eisele, P. J.; Hartung, R. THE EFFECTS OF METHOXYCHLOR ON RIFFLE INVERTEBRATE POPULATIONS AND COMMUNITIES. Trans. Am. Fish. Soc. 105 (5): 628-633. Sept. 1976. SFA 21(4).
[Eng. Res. Dep., Detroit Edison Co., 2000 Second Ave., Detroit, MI 48226] A study was conducted to evaluate the chronic effects of a toxicant on interacting stream invertebrate populations. The study involved the continuous dosing of a small stream at 0.2 ug/liter methoxychlor for over one year. Invertebrate populations were monitored by artificial substrate and bottom sample collections of riffle invertebrates. Most invertebrate populations experienced some reduction due to the stream dosing. Some taxa (baetids and plecopterans) were affected as reflected by population reductions in dosed areas. Many taxa (hydropsychids, simulids, and aeschnids) were temporarily affected, experiencing initial population reductions in dosed areas but then recovering to control levels. Other taxa (chironomids and elmids) were not affected by the pesticide dosing. The riffle invertebrate community colonizing artificial substrates experienced a temporary decrease in diversity through both reduced richness and evenness. Diversity was not decreased in bottom sample collections. In general, most long-term effects were minor in comparison to naturally occurring phenomena such as flooding.

76-001589 Fabacher, D. L. TOXICITY OF ENDRIN AND AN ENDRIN-METHYL PARATHION FORMULATION TO LARGEMOUTH BASS FINGERLINGS. Bull. Environ. Contam. Toxicol. 16 (3): 376-378. Sept. 1976. SFA 21(4)
[Dep. Entomol., N.C. State Univ., Raleigh 27607] The 24 and 48 hr. LC(50) values for endrin to bass fingerlings were 0.49 and 0.27 ppb respectively. The 24 and 48 hr. LC(50) values of the endrin-methyl parathion formulation were 0.48 and 0.37 ppb respectively. Fish treated with 0.1 ppb endrin or 0.1 ppb endrin-methyl parathion showed 40 percent mortality in both assays on the 20th day after initial exposure. Average endrin residues in 4 dead fish from each assay were 0.0115 ppm in the endrin assay and 0.0165 ppm in the endrin-methyl parathion assay. The data show that methyl parathion has no significant effect on the toxicity of endrin alone. Observed differences in toxicity could be a result of some other component(s) in the endrin-methyl parathion mixture, since this was a diluted formulation.--From results and discuss.

76-001590 Fabacher, D. L.; Chambers, H. UPTAKE AND STORAGE OF ^{14}C-LABELED ENDRIN BY THE LIVERS AND BRAINS OF PESTICIDE-SUSCEPTIBLE AND RESISTANT MOSQUITOFISH. Bull. Environ. Contam. Toxicol. 16 (2): 203-207. Aug. 1976. SFA 21(4)
[Dep. Entomol., N.C. State Univ., Raleigh 27607]

76-001591 Folmar, L. C. OVERT AVOIDANCE REACTION OF RAINBOW TROUT TO NINE HERBICIDES. Bull. Environ. Contam. Toxicol. 15 (5): 509-514. May 1976. SFA 21(4)
[U.S. FWS, Fish-Pesticide Res. Lab., Denver, CO] In general, the results of these studies suggest that rainbow trout would not be killed by, and would not avoid, relatively low concentrations of dalapon, 2,4-D (DMA), glyphosate, Aquathol K, diquat, or TCA. However, trout present in acrolein-treated water probably would not avoid a lethal exposure. Trout strongly avoided low concentrations of copper sulfate and 0.1 mg/l xylene; although these chemicals are non-toxic at the levels tested, their presence in the water may influence the selection of habitat by fish.--From discuss. and results.

76-001592 Grant, B. F. ENDRIN TOXICITY AND DISTRIBUTION IN FRESHWATER: A REVIEW. Bull. Environ. Contam. Toxicol. 15 (3): 283-290. Mar. 1976. SFA 21(4)
[U.S. FWS, Southeast Fish Cult. Lab., Marion, AL 36756] Forty-nine reports containing useful information about endrin are summarized herein. This review should be helpful in evaluating potential consequences of continued endrin use and its impact as an aquatic pollutant. These and other investigations are the basis for recommended maximal amounts of 2 pptr endrin in water if aquatic organisms are to be protected (/Water Quality Criteria 1972/).

76-001593 Gregg, B. C.; Heath, A. G. A METHOD FOR INTERMITTENT CHLORINE DOSING IN CONTINUOUS-FLOW TOXICITY TESTS. Bull. Environ. Contam. Toxicol. 13 (5): 588-592. May 1975. SFA 21(4)
[Dep. Biol. Cent. Environ. Stud., VPI & SU, Blacksburg, VA 24061] The cooling lines through the condensers in steam electric generating plants frequently become fouled with attached organisms which reduce cooling efficiency and decrease water flow rate. In many plants a chlorine solution is fed for several short periods each day to treat problem areas and then is discharged as condenser blow-down. To study the toxic effects of these discharges on the organisms in the receiving water, there is a need for an intermittent delivery system to simulate the down-stream conditions, such as the chlorine pulses. We here describe the composition and operation of an intermittent delivery system used to perform chlorine toxicity tests on macroinvertebrates.--From intrc.

76-001594 Griffin, J. M.; West, J. L. ACUTE TOXICITY OF AMMONIA-BASE NEUTRAL SULFITE PULP MILL WASTE LIQUOR TO RAINBOW TROUT. Bull. Environ. Contam. Toxicol. 15 (5): 608-612. May 1976. SFA 21(4)
[Rollins Anim. Dis. Diagnostic Lab., NCDA, P.O. Box 12223 Cameron Village Station, Raliegh, NC 27611] The acute toxicity to rainbow trout of untreated ammonia-base neutral sulfite pulp mlill waste liquor was demonstrated in these experiments. A mean LC50 of 0.82 percent and 95 percent confidence interval of 0.08 - 1.56 percent was obtained in four static bicassays. Lignin, sulfur dioxide, and ammonia were implicated as toxic components. The latter two were probably the most toxic.--Summ.

76-001595 Gutenmann, W. H.; Lisk, D. J. FLAME RETARDANT RELEASE FROM FABRICS DURING LAUNDERING AND THEIR TOXICITY TO FISH. Bull. Environ. Contam. Toxicol. 14 (1): 61-64. July 1975. SFA 21(4)
[Dep. Food Sci., Cornell Univ., Ithaca, NY 14850]

76-001596 Heisinger, J. F.; Green, W. MERCURIC CHLORIDE UPTAKE BY EGGS OF THE RICEFISH AND RESULTING TERATOGENIC EFFECTS. Bull. Environ. Contam. Toxicol. 14 (6): 665-673. Dec. 1975. SFA 21(4)
[Dep. Biol., Univ. S. Dak., Vermillion 57069] Eggs collected from adult Japanese Medaka were incubated for 16 days in solutions containing 10, 15, 20, and 30 ppb mercury as mercuric chloride. The mean hatchability of control eggs was 46.7 percent. Experimental eggs incubated in 10 ppb and 15 ppb mercury had hatching percentages of 58.3 and 20.8 respectively. None of the 20 ppb or 30 ppb experimental eggs hatched. Hemorrhaging, blcod vessel deterioration and loss of blood cells were observed in 79 percent of the 15 ppb experimental eggs and all the 20 and 30 ppb experimental eggs. Neither the control nor the 10 ppb experimental eggs demonstrated any of these abnormalities. The LC(100) for 384 hours was between 20 ppb and 30 ppb. The 10, 15, 20 and 30 ppb experimental eggs concentrated mercury directly from the incubating sclution 1,600, 1,900, 2,700, and 1,900 times, respectively. The total concentration of mercury in these eggs after 16 consecutive days was 16,000, 29,000, 54,000, and 56,000 respectively.--From summ.

76-001597 Hill, D. W.; Hejtmancik, E.; Camp, B. J. INDUCTION OF HEPATIC MICROSOMAL ENZYMES BY AROCLOR 1254 IN /ICTALURUS PUNCTATUS/ (CHANNEL CATFISH). Bull. Environ. Contam. Toxicol. 16 (4): 495-502. Oct. 1976. SFA 21(4)
[Dep. Vet. Physiol. Pharmacol., Texas A&M Univ., College Station]

76-001598 Kanazawa, J. UPTAKE AND EXCRETION OF ORGANOPHOSPHORUS AND CARBAMATE INSECTICIDES BY FRESH WATER FISH, MOTSUGO, /PSEUDORASBORA PARVA/. Bull. Environ. Contam. Toxicol. 14 (3): 346-352. Sept. 1975. SFA 21(4)
[Natl. Inst. Agric. Sci. 2-1, Nishigahara, Kita-Ku, Tokyo, 114 Japan] Fresh water fish, Motsugo was reared in aquarium water tank containing about 1 ppm of 3 organophosphorus and 3 carbamate insecticides for about 30 days. Among organophosphorus insecticides, malathion is the most unstable in water, and degraded more than 99 percent for 7 days. Penitrothion is moderately stable, and degraded 97 percent for 29 days. Diazinon is the most stable, and degraded 72 percent for 30 days. Among carbamates, carbaryl is the most unstable in water, and degraded more than 95 percent for 6 days. BPMC is moderately stable, and degraded 80 percent for 32 days. XMC is the most stable, and degraded 45 percent for 34 days. As for the uptake of the pesticides by fish, organophosphorus insecticides were generally higher than carbamate insecticides. The concentration of diazinon in fish reached to 211 ppm of the maximum level after 3 days, and that of fenitrothion reached to 162 ppm of the maximum level after 4 days. Afterwards, the concentration of both the insecticides decreased gradually due to the metabolism and excretion of the insecticides in fish. Uptake of malathion was very low and metabolized rapidly, and its concentration became to less than 0.01 ppm after 7 days. Among carbamate insecticides, the concentration of carbaryl in fish after one day reached to 7.5 ppm which was the maximum level of uptake. On the other hand, the concentration of BPMC in fish after 4 days became to 4.8 ppm, which was the maximum level, and decreased gradually. The

76-001598 CONTINUED
concentration of XMC in fish was only 1.4 ppm after one day, but the metabolism rate of XMC in fish was fairly slow. Therefore, 0.55 ppm of XMC in fish remained even after 34 days. Moreover, in the test tank of diazinon, fenitrothion and BPMC, the appearance of deformed fish with spinal curvature of back bone came out at the rate of 10 to 30 percent.--From summ.

76-001599 Kendall, M. W. ACUTE EFFECTS OF METHYL MERCURY TOXICITY IN CHANNEL CATFISH (/ICTALURUS PUNCTATUS/) KIDNEY. Bull. Environ. Contam. Toxicol. 13 (5): 570-578. May 1975. SFA 21(4)
[Sch. Med. Sci., Univ. Nevada, Reno 89507] The results of this study have shown in the channel catfish: a single intraperitoneal injection of 15 mg/kg methyl mercuric chloride caused deposition of mercury in the kidney; inhibition of histochemically localized succinic dehyrogenase activity; marked pathology as evidenced by necrosis of renal tubular cells and increased thickening of renal glomerular basement membrane.--From Concl.

76-001600 Khan, H. M.; Neudorf, S.; Khan, M. A. Q. ABSORPTION AND ELIMINATION OF PHOTODIELDRIN BY /DAPHNIA/ AND GOLDFISH. Bull. Environ. Contam. Toxicol. 13 (5): 582-587. May 1975. SFA 21(4)
[Dep. Biol. Sci., Univ. Ill. at Chicago Circle, Chicago] The alga, /Ankistrodesmus spiralis/, becomes saturated with photodieldrin in 8 hours. The /Daphnia/ whether contaminated by feeding on the algae saturated with photodieldrin or by directly absorbing this insecticide eliminate about 50 per cent of the absorbed photodieldrin in 4 days which increases up to 70 per cent in 7 days. However, continuous exposure of daphnids to photodieldrin results in increased absorption and accumulation of this insecticide. Transfer of the goldfish contaminated with photodieldrin to clean water results in initial elimination in 24 hours whose rate is then subsequently reduced. These two organisms are thus capable of eliminating their body residues of photodieldrin, the "terminal residue" of dieldrin, if their environment is decontaminated.--Summ.

76-001601 Klaunig, J.; Kcepp, S.; McCormick, M. ACUTE TOXICITY OF A NATIVE MUMMICHOG POPULATION (/FUNDULUS HETEROCLITUS/) TO MERCURY. Bull. Environ. Contam. Toxicol. 14 (5): 534-536. Nov. 1975. SFA 21(4)
[Biol. Dep., Montclair State Coll., Upper Montclair, NJ 07043] One hundred percent survival was obtained with dosages of mercuric chloride ranging up to 0.86 mg/liter. These fish showed no visible response to the presence of the toxicant. However, an increasingly sluggish behavior developed in those fish surviving exposure levels above 1.15 mg/liter. Survivors of dosages exceeding the calculated TLM (2.0 mg/liter) demonstrated a pronounced negative phototaxy. Expiring mummichogs exhibited two distinctly different responses, depending on the toxicant dosage. Fish exposed to intermediate levels (1.5 - 2.0 mg/l) characteristically developed uncoordinated swimming movements, suggestive of equilibrium dysfunction. On the other hand, exposure to maximal levels of the toxicant invoked a marked increase in the opercular rate, reflecting obvious respiratory stress. Such fish always died within 24 hours after initial exposure.--From results and discuss.

76-001602 Knauf, W. GERAETE ZUR DURCHFUEHRUNG TOXIKOLOGISCHER LANGZEITSTUDIEN AN WASSERORGANISMEN. [DEVICES FOR TOXICOLOGICAL LONG-TERM STUDIES ON AQUATIC ORGANISMS.] Arch. Fischereiwiss. 26 (3):103-108. Apr. 1975. In German with English summ. SFA 21(4)
[Oekol. Labor Pflanzenschutzforsch. Hoechst AG, Frankfort/M., West Germany] For the performance of dynamic tests with water-organisms two different types of through-flowing-apparatus are described and the experiences in running the devices. They are built from normal laboratory material; also the basic principal is uncomplicated and the tests safe. They can be used for experiments with chronic toxicity determination of threshold-concentrations and for residue studies.

76-001603 Kobylinski, G. J.; Livingston, R. J. MOVEMENT OF MIREX FROM SEDIMENT AND UPTAKE BY THE HOGCHOKER, /TRINECTES MACULATUS/. Bull. Environ. Contam. Toxicol. 14 (6): 692-698. Dec. 1975. SFA 21(4)
[Dep. Biol. Sci., Fla. State Univ., Tallahassee, FL 32306] Mirex contaminated sediments of the static test retained virtually all of the insecticide over a 4 week period. About 40 percent of the initial concentration was lost from the sediment under constant flow conditions. Mirex in water was directly related to levels of mirex in sediment. Mirex in water reached an equilibrium during the first week and declined over the following 3 weeks. Uptake of mirex by tissues showed a dose dependent relationship. Accumulation of the insecticide increased over time and did not appear to reach an equilibrium. Residues in the muscle of fish increased significantly with time (p less than .01) and test concentration (p less than .01). Mirex in the liver of fish increased significantly with time (p less than .05) of the flow-through test. Declining levels of mirex in water indicated mirex was absorbed from the water by the fish. Considerably more mirex, however, was gained by the fish than was lost from the water. Thus the fish probably absorbed a significant amount of mirex from the sediments.--Summ.

76-001604 Kramer, H. J.; Neidhart, B. THE BEHAVIOUR OF MERCURY IN THE SYSTEM WATER--FISH. Bull. Environ. Contam. Toxicol. 14 (6): 699-704. Dec. 1975. SFA 21(4)
[Fachber. Anorg. Chem. Kernchem., Tech. Hochsch. Darmstadt, Darmstadt, West Germany] The release of inorganic mercury is about 17 times as fast as the release of incorporated methyl-mercurychloride. Accumulated inorganic mercury is methylated in the fish, and after this the release is identical to that of methyl-mercurychloride.--From results and discuss.

76-001605 Kuhnert, P. M.; Kuhnert, B. R.; Stokes, R. M. THE EFFECT OF /IN VIVO/ CHROMIUM EXPOSURE ON NA/K- AND MG-ATPASE ACTIVITY IN SEVERAL TISSUES OF THE RAINBOW TROUT (/SALMO GAIRDNERI/). Bull. Environ. Contam. Toxicol. 15 (4): 383-390. Apr. 1976. SFA 21(4)
[Cleveland Met. Gen. Hospital, Case West. Reserve Univ., Cleveland, OH 44109] The effect of /in vivo/ chromium exposure on Na/K- and Mg-ATPase activity was studied in several tissues of the rainbow trout, /Salmo gairdneri/. Those tissues studied were: intestine, gill, liver, and kidney. Tissue chromium levels were determined for control rainbow trout and trout exposed to 2.5 mg Cr/l (as chromate) for 48 hours. After exposure to chromium, inhibition of Na/K-ATPase activity, but not Mg ATPase activity, was observed. These results may partially explain the detrimental effects of hexavalent chromium on fish.

76-001606 Lee, D. R. DEVELOPMENT OF AN INVERTEBRATE BIOASSAY TO SCREEN PETROLEUM REFINERY EFFLUENTS DISCHARGED INTO FRESHWATER. Ph. D. dissertation, Va. Polytech. Inst. & State Univ. 118p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(4), 1976. SFA 21(4)

A simple method using unsophisticated equipment is suggested for on-site toxicity testing of refinery effluents. This method will provide an inexpensive means of identifying problem materials and establishing priorities for coping with these materials. An arbitrary reference mixture (ARM), containing six common constituents of refinery wastewaters, was used for static toxicity tests on 15 species of freshwater invertebrates and three species of fish. /Daphnia pulex/ was selected for further testing because it was the most sensitive of the animals tested, relatively inexpensive and easy to maintain, and a potential fish-food organism. If the reference mixture were representative of a refinery effluent, the /Daphnia/ bioassay would be sufficiently sensitive to give reliable results within 48 h, whereas a fish bioassay would show no toxicity even after 96 h.--From abstr.

76-001607 Lee, J. H.; Sylvester, J. R.; Nash, C. E. EFFECTS OF MIREX AND METHOXYCHLOR ON JUVENILE AND ADULT STRIPED MULLET, /MUGIL CEPHALUS/ I. Bull. Environ. Contam. Toxicol. 14 (2): 180-186. Aug. 1975. SFA 21(4)

[Ocean. Inst., Makapuu Point, Waimanalo, HI 96795]

76-001608 Macek, K. J. ACUTE TOXICITY OF PESTICIDE MIXTURES TO BLUEGILLS. Bull. Environ. Contam. Toxicol. 14 (6): 648-652. Dec. 1975. SFA 21(4)

[Bionomics, EG&G, Inc., P.O. Box 135, Wareham, MA 02571] eleven combinations of chemicals tested had greater than additive toxicity to bluegills. Six of these combinations were later tested with rainbow trout (/Salmo gairdneri/) to compare species susceptibility and the results were closely similar to those obtained with bluegills. Seventeen combinations had no more than what appears to be additive toxicity, and one--malathion and copper sulfate--had less than additive toxicity. The results of the toxicity tests with DDT, one of the most widely distributed and persistent synthetic chemicals in aquatic ecosystems, were encouraging in that DDT did not have greater than additive toxicity with any of the pesticides tested except BHC. On the other hand, three observations were disquieting: First, and most important, was that greater than additive toxicity between commonly used pesticides was observed in more than one-third of the combinations tested. Second, many organophosphorus insecticides being proposed as alternatives to the more persistent pesticides were particularly active when combined with other chemicals. Third, several combinations currently recommended by the U.S. Department of Agriculture had greater than additive toxicity to bluegills. The results of this study indicate that further research on the interaction of pesticides in aquatic environments is urgently needed to protect fishery resources.--From results and discuss.

76-001609 Macek, K. J.; Krzeminski, S. F. SUSCEPTIBILITY OF BLUEGILL SUNFISH (/LEPOMIS MACROCHIRUS/) TO NONIONIC SURFACTANTS. Bull. Environ. Contam. Toxicol. 13 (3): 377-384. Mar. 1975. SFA 21(4)

[Bionomics, EG&G, Inc., Warham, MA] The present report provides a basis for direct comparison of the susceptibility of fish to alkylphenol alcohol ethoxylates of various EO chain lengths. It is obvious from the data provided that susceptibility of bluegill to nonionic surfactants (both types) increases with decreasing EO chain length. Also it appears that bluegill are no more susceptible, and, in

76-001609 CONTINUED
fact, and, probably less susceptible to the acute effects of alkylphenol ethoxylates than of alcohol ethoxylates.--Summ.

76-001610 Maciorowski, A. F. AN INEXPENSIVE MACROINVERTEBRATE BIOASSAY TABLE FOR USE IN CONTINUOUS-FLOW TOXICITY TESTS. Bull. Environ. Contam. Toxicol. 13 (4): 420-423. Apr. 1975. SFA 21(4)

76-001611 Margrey, S. L.; Burton, D. T.; Richardson, L. B. A PRELIMINARY STUDY OF CHLORINE TOXICITY TO ATLANTIC MENHADEN (/BREVOORTIA TYRANNUS/) AND HOGCHOKER (/TRINECTES MACULATUS/). ASB (Assoc. Southeast. Biol.) Bull. 23 (2): 78. Apr. 1976. SFA 21(4).
Atlantic menhaden (/Brevoortia tyrannus/) and hogchoker (/Trinectes maculatus/) were exposed to chlorine applied on both continual and intermittent schedules. Total residual chlorine concentrations of 0.125, 0.25, 0.50, 1.0 and 2.0 mgl^{-1} were applied continuously while 0.5, 1.0 and 2.0 mgl^{-1} were introduced intermittently for 15 mintues every 3 hours and 30 minutes every 6 hours. An intermittent test at a concentration of 0.25 mgl^{-1} was run for 60 minutes every 2 hours. All tests were conducted at 15-20°C for 96 hours or until 100 percent mortality occurred. One hundred percent of the menhaden died in nine of 12 tests (five continuous tests; seven intermittent tests); mortality ranged from 10 to 90 percent in the remaining three tests. In contrast, 100 percent mortality occurred in only one of 12 hogchoker tests; mortality ranged from 30 to 70 percent in four tests and no mortality occurred in the remaining seven tests. Time to death for both species was inversely proportional to the chlorine concentration under both the continuous and intermittent schedules. In general, fish survived longer when exposed to intermittent rather than continuous schedules.

76-001612 Marking, L. L.; Mauck, W. L. TOXICITY OF PAIRED MIXTURES OF CANDIDATE FOREST INSECTICIDES TO RAINBOW TROUT. Bull. Environ. Contam. Toxicol. 13 (5): 518-523. May 1975. SFA 21(4)
[U.S. FWS, Fish Control Lab., La Crosse, WI 54601] The toxicities of Zectran, Dylox, Volaton, Guthion, pyrethrum extract, and the synthetic pyrethroids SEP-1382, and RU-11679 were determined individually and in paired mixtures against rainbow trout. The carbamate Zectran was the least toxic, and the synthetic pyrethroids were the most toxic. Nine of the mixtures produced less than additive toxicity (antagonism), nine produced additive toxicity, and two produced greater than additive toxicity (synergism). None of the mixture toxicities deviated markedly from additive, and only two pairs of mixtures would pose a greater toxicological hazard to fish than the respective individual chemicals.--Summ.

76-001613 Mayer, F. L. RESIDUE DYNAMICS OF DI-2-ETHYLHEXYL PHTHALATE IN FATHEAD MINNOWS (/PIMEPHALES PROMELAS/). J. Fish. Res. Board Can. 33 (11): 2610-2613. Nov. 1976. In English with French summ. SFA 21(4).
[U.S. FWS, Fish Pesticides Res. Lab., Columbia, MO 65201] Fathead minnows (/Pimephales promelas/) were continuously exposed to 1.9-62 ug/liter di-2-ethylhexyl phthalate (DEHP) for 56 days. The accumulation factors ranged downward from 886 to 155 as the exposure concentrations increased. The major metabolite of DEHP was the monoester, 2-ethylhexyl phthalate. After being placed in uncontaminated water, the fish eliminated half of the DEHP in 12.2 days.

76-001614 Mayes, R. A. THE ROLE OF AQUATIC MACROPHYTES IN THE DISTRIBUTION AND CYCLING OF CADMIUM AND LEAD IN AQUATIC ECOSYSTEMS. Ph. D. dissertation, Purdue Univ. 221p. 1975. From Diss. Abstr. Int. B Sci. Eng. 37(3), 1976. SFA 21(4)

Samples of coontail were removed from a control pond with no known inputs of metals and transplanted into four systems which received known or suspected metal inputs. A borrow pit near Gary and Stone and Clear Lakes in LaPorte were thought to receive trace metals from aerial sources; in contrast, Little Center Lake, near Angola, received a direct input from treated wastewater from an electroplating shop. The transplanted samples were put into porous containers at three locations in each system, including the control pond, and were monitored for Cd and Pb content during a 12-week period. Coontail in Little Center Lake accumulated both metals to a greater extent than did plants in the other areas. There were no great differences in Cd accumulation in coontail from the other four systems. Elevated Pb levels were observed in plants from the borrow pit and Clear Lake. Pb concentrations in the borrow pit reflected the proximity of the heavily traveled Indiana Toll Road, while high Pb levels in Clear Lake probably were related to its use as a dumping area for snow removed from city streets. Estimated concentration factors for coontail from all systems ranged from $1 \times 10^3 - 1 \times 10^5$.--From abstr.

76-001615 McKim, J. M.; Arthur, J. W.; Thorslund, T. W. TOXICITY OF A LINEAR ALKYLATE SULFONATE DETERGENT TO LARVAE OF FOUR SPECIES OF FRESHWATER FISH. Bull. Environ. Contam. Toxicol. 14 (1): 1-7. July 1975. SFA 21(4)

[U.S. EPA, 6201 Congdon Blvd., Duluth, MN 55804]

76-001616 Melancon, M. J., Jr.; Lech, J. J. ISOLATION AND IDENTIFICATION OF A POLAR METABOLITE OF TETRACHLOROBIPHENYL FROM BILE OF RAINBOW TROUT EXPOSED TO ^{14}C-TETRACHLOROBIPHENYL. Bull. Environ. Contam. Toxicol. 15 (2): 181-188. Feb. 1976. SFA 21(4)

[Dep. Pharmacol., Med. Coll. Wis., Milwaukee 53233] The present report demonstrated the appearance, in rainbow trout bile, of ^{14}C-labelled conjugated metabolites following exposure to ^{14}C-labelled TCB. After glucuronidase hydrolysis, the TMS ether of one of the compounds matched the TMS ether of hydroxy TCB during gas chromatography. Although the extent of TCB metabolism by rainbow trout and also by sunfish appears to be slight, even this low level of metabolism could be important in view of the high concentration of PCBs found in various fish species and the possibility of significant amounts of HO-PCBs being released into the environment from the large fish biomass.--From results and discuss.

76-001617 Miller, D. L.; Ogilvie, D. M. TEMPERATURE SELECTION IN BROOK TROUT (/SALVELINUS FONTINALIS/) FOLLOWING EXPOSURE TO DDT, PCB OR PHENOL. Bull. Environ. Contam. Toxicol. 14 (5): 545-551. Nov. 1975. SFA 21(4)

[Dep. Zool., Univ. West Ontario, London, ON N6A 3K7, Canada]

76-001618 Negilski, D. S. ACUTE TOXICITY OF ZINC, CADMIUM AND CHROMIUM TO THE MARINE FISHES, YELLOW-EYE MULLET (/ALDRICHETTA FORSTERI/ C.&V.) AND SMALL-MOUTHED HARDYHEAD (/ATHERINASOMA MICROSTOMA/ WHITLEY). Aust. J. Mar. Freshwater Res. 27 (1): 137-149. Mar. 1976. SFA 21(4).

[Minist. Conserv., 605 Flinders St. Ext., Melbourne, Vic. 3000, Australia] In static tests with juvenile mullet, the acute incipient lethal level for zinc was 9 mg/l, the 168-h LC(50) value for cadmium was 16 mg/l, and the 96-h LC(50) values for tri- and hexavalent chromium were 53 and 24 mg/l respectively; in similar tests with pre-adult hardyhead, the acute incipient lethal level for zinc was 33 mg/l and the 168-h LC(50) value for cadmium was 21 mg/l. In continuous-flow tests with mullet the acute incipient lethal level for zinc was 12 mg/l, but incipient lethal levels were not attained for cadmium or chromium; however, the 120-h LC(50) value for cadmium and the 96-h LC(50) value for hexavalent chromium were 14 and 31 mg/l respectively. In similar tests with hardyhead, incipient lethal levels for zinc and chromium were 37 and 36 mg/l respectively. An acute incipient lethal level for cadmium was not attained, but the 168-h LC(50) value was 15 mg/l. Generally, mullet and hardyhead were more sensitive to the acute effects of cadmium, chromium and zinc than other marine and estuarine fishes for which toxicological information is available. Increased temperature also appeared to increase the sensitivity of mullet to the lethal effects of zinc.

76-001619 Newbold, C. HERBICIDES IN AQUATIC SYSTEMS. Biol. Conserv. 7 (2): 97-118. Feb 1975. SFA 21(4)

[Inst. Terrestrial Ecol., Huntingdon, PE17 2LS, Great Britain] The use of aquatic herbicides in Britain appears to be increasing. The ecological effects on aquatic ecosystems depend on the type of herbicide applied, the treatment level and the frequency of spraying. Short-term effects could involve a reduction in oxygen, an increase in carbon dioxide, a lowering of the pH, an increase in bacterial populations, a change in the nutrient status of the water and in plant communities, with a consequent alteration of habitat for the fauna. Long-term ecological effects depend on the degree of habitat destruction, the persistence of the herbicide, resulting in suppression of renewed plant growth, and the suitability of any colonising or non-susceptible plant species in providing a habitat for the fauna. The characteristics of twelve herbicides--diquat, paraquat, dichlobenil, chlorthiamid, terbutryne, dalapon, diuron, asulma, copper sulphate, maleic hydrazide, maleic hydrazide/2,4-D/chlorpropham, and 2,4-D amine--are discussed.

76-001620 Nuorteva, P.; Hasanen, E. BIOACCUMULATION OF MERCURY IN /MYOXOCEPHALUS QUADRICORNIS/ (L.) (TELEOSTEI, COTTIDAE) IN AN UNPOLLUTED AREA OF THE BALTIC. Ann. Zool. Fenn. 12: 247-254. 1975. SFA 21(4).

[Dep. Environ. Sci., Univ. Helsinki, SF-00710 Helinski 71, Finland] In the unpolluted Bromarv area of the Baltic the mean mercury content was 0.03 ppm in invertebrates, 0.10 ppm in the flesh of fishes that feed on invertebrates, 0.29 ppm in the flesh of piscivorous fishes, 0.35 ppm in sarcophagous flies reared on invertebrate-eating fishes and more than 2 ppm in the flesh of fish-eating migratory birds. The mercury content of the stenothermal fish /Mycxccephalus quadricornis/ increased with size to a maximum value of 0.47 ppm. Observations from an area moderately polluted with mercury showed a notably accelerated accumulation of mercury, which was evident from the increased slope of the line illustrating the regression of mercury content on body size. This and earlier observations indicate that the balanced natural condition of mercury circulation is characterized by regression

76-001620 CONTINUED
coefficients near zero. The mercury contents of other invertebrate-eating fishes living in the same environment at Bromary were below the suggested maximum background level of 0.2 ppm. The exceptionally strong bioaccumulation of mercury in /M. quadricornis/ is probably a result of its feeding on mysidaceans which have a higher mercury content (0.06-0.09 ppm) than other invertebrates (0.01-0.03 ppm). The transfer of such peak concentrations along the food chain is possible only in oligotrophic conditions, where there are relatively few species and each predator has a limited spectrum of prey animals.

76-001621 O'Connor, D. V.; Fromm, P. O. THE EFFECT OF METHYL MERCURY ON GILL METABOLISM AND BLOOD PARAMETERS OF RAINBOW TROUT. Bull. Environ. Contam. Toxicol. 13 (4): 406-411. Apr. 1975. SFA 21(4)
[Mich. State Univ., East Lansing 48824]

76-001622 Olson, G. F.; Mount, D. I.; Snarski, V. M. MERCURY RESIDUES IN FATHEAD MINNOWS, /PIMEPHALES PROMELAS/ RAFINESQUE, CHRONICALLY EXPOSED TO METHYLMERCURY IN WATER. Bull. Environ. Contam. Toxicol. 14 (2): 129-134. Aug. 1975. SFA 21(4)
[U.S. EPA, 6201 Congdon Blvd., Duluth, MN 55804] Fathead minnows were exposed to methylmercury water concentrations ranging from 0.018 to 0.247 ug/liter. After 48 weeks of exposure (sufficient time for a life cycle), the total mercury residues in the whole fish body ranged from 1.47 ug/gram in fish from the lowest concentration tested to 10.90 ug/gram in fish from the highest. The control fish living in water with concentrations of mercury less than 0.01 ug/liter contained 0.21 ug/gram total body residue. These body concentrations are the result of a continuous water exposure and a probable intake from a portion of the food eaten.

76-001623 Perna, A.; Di Giacinto, L. RICERCA PER VIA MICROBIOLOGICA DI SOSTANZE INIBENTI LO SVILUPPO BATTERICO E LORO PERSISTENZA NELLE CARNI, NEL FEGATO E NELL'INTESTINO DI TROTE ALIMENTATE CON ALCUNI MANGIMI COMPOSTI INTEGRATI MEDICATI. [MICROBIOLOGICAL RESEARCH OF SUBSTANCES INHIBITING BACTERIAL GROWTH AND THEIR PERSISTENCY IN FLESH, LIVER, AND INTESTINE OF TROUT FED WITH MEDICATED COMPOUND FEEDS.] Riv. It. Piscic. Ittiop. 11 (3): 73-79. July-Aug.-Sept. 1976. In Italian with English summ. SFA 21(4).
[L. Di Giacinto: Ist. Sper. Igrene Cont. Vet. Pesca, via R. Paolucci-65100, Pescara, Italy] The research aimed to ascertain the effective persistency of residues of substances, with an antimicrobial power, in flesh and in organs of trout fed medicated compound feeds. The interval of time (30 days), following cessation of therapy before fish marketing, required by the Italian regulation may be considered as excessive. The residues of the investigated antimicrobial drugs, in fact, were no longer detectable, by using microbiological tests, in the muscle and other organs (liver, intestine), after 4 days in pellets medicated with Furazolidone, Chlortetracycline, or Furaltadone tartrate; after 14 days if pellets were medicated with Oxytetracycline.--Summ.

76-001624 Pfuderer, P.; Francis, A. A. PHTHALATE ESTERS: HEARTRATE DEPRESSORS IN THE GOLDFISH. Bull. Environ. Contam. Toxicol. 13 (3): 275-279. Mar. 1975. SFA 21(4)
[Biol. Div., Oak Ridge Natl. Lab., Oak Ridge, TN 37830]

76-001625 Rand, G. M. THE EFFECT OF EXPOSURE TO A SUBACUTE CONCENTRATION OF PARATHION ON THE LOCOMOTOR BEHAVIOR OF SEVERAL FRESHWATER FISH. Ph. D. dissertation, Texas A&M Univ. 118p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(3), 1976. SFA 21(4)

76-001626 Rehwoldt, R.; Karinian-Teherani, D. UPTAKE AND EFFECT OF CADMIUM ON ZEBRAFISH. Bull. Environ. Contam. Toxicol. 15 (4): 442-446. Apr. 1976. SFA 21(4)
[Marist Coll., Poughkeepsie, NY]

76-001627 Scherer, E. AVOIDANCE OF FENITROTHION BY GOLDFISH (/CARASSIUS AURATUS/). Bull. Environ. Contam. Toxicol. 13 (4): 492-496. Apr. 1975. SFA 21(4)
[Dep. Environ., Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB R3T 2N6, Canada] Goldfish (/Carassius auratus/) avoided water containing the pesticide fenitrothion. The response was graded over the tested concentration range of 5 orders of magnitude, with a threshold around 10 ug/l, equivalent to 3.5×10^{-8} M.

76-001628 Schreck, C. B.; Brouha, P. DISSOLVED OXYGEN DEPLETION IN STATIC BIOASSAY SYSTEMS. Bull. Environ. Contam. Toxicol. 14 (2): 149-152. Aug. 1975. SFA 21(4)
[Oreg. Coop. Fish. Res. Unit., Oreg. State Univ., Corvallis 97331]

76-001629 Sims, G. G.; Cosham, C. E.; Campbell, J. R.; Murray, M. C. DDT RESIDUES IN COD LIVERS FROM THE MARITIME PROVINCES OF CANADA. Bull. Environ. Contam. Toxicol. 14 (4): 505-512. Oct. 1975. SFA 21(4)
[Environ. Can., Fish. Mar. Serv., Halifax, NS B3J 2S7, Canada] The residues of DDT and its analogs were estimated in a number of cod liver samples (/Gadus morhua/) collected at six sampling sites off the Atlantic Coast of the Maritime Provinces of Canada during the summer of 1971. The residue levels indicated widespread distribution of DDT over the entire region sampled. Variations in the relative contributions of p,p'-DDE and p,p'-DDT to the total DDT residues were noted and the tendency for these residues to preferentially accumulate in lipid rich tissues was demonstrated. The residue levels found in cod livers were compared to the residue levels determined in cod flesh taken from some of the same specimens and also to residue levels in commercially refined cod liver oils. Samples of each of these types were stored at -29°C and analyzed in 1973 for DDT and PCB simultaneously. The total DDT residues determined by both methods of analysis were compared.

76-001630 Smith, B. P.; Hejtmancik, E.; Camp, B. J. ACUTE EFFECTS OF CADMIUM ON /ICTALURUS PUNCTATUS/ (CATFISH). Bull. Environ. Contam. Toxicol. 15 (3): 271-277. Mar. 1976. SFA 21(4)
[Dep. Vet. Physiol. Pharmacol., Texas A&M Univ., College Station]

76-001631 Sorensen, E. M. B. TOXICITY AND ACCUMULATION OF ARSENIC IN GREEN SUNFISH, /LEPOMIS CYANELLUS/, EXPOSED TO ARSENATE IN WATER. Bull. Environ. Contam. Toxicol. 15 (6): 756-761. June 1976. SFA 21(4)
[Dep. Zool., Univ. Texas, Austin 78712]

76-001632 Tagatz, M. E. EFFECT OF MIREX ON PREDATOR-PREY INTERACTION IN AN EXPERIMENTAL ESTUARINE ECOSYSTEM. Trans. Am. Fish. Soc. 105 (4): 546-549. July 1976. SFA 21(4).
[U.S. EPA, Environ. Res. Lab., Gulf Breeze, FL 32561] Tests of 14- to 16-days duration were conducted to determine the distribution and sublethal effects of mirex in an experimental estuarine ecosystem. The insecticide was translocated from water at concentrations of 0.011 to 0.13 ug/liter to sand, plant, and animal components. An alteration of predator-prey interaction due to mirex was manifested by a significant difference (chi-square test, /a/ = 0.05) in survival of grass shrimp, /Palaemonetes vulgaris/, in control and treated tanks after one, two, or three days of predation by pinfish, /Lagodon rhomboides/.

76-001633 Thatcher, T. O.; Schneider, M. J.; Wolf, E. G. BIOASSAYS ON THE COMBINED EFFECTS OF CHLORINE, HEAVY METALS AND TEMPERATURE ON FISHES AND FISH FOOD ORGANISMS. PART I. EFFECTS OF CHLORINE AND TEMPERATURE ON JUVENILE BROOK TROUT (/SALVELINUS FONTINALIS/). Bull. Environ. Contam. Toxicol. 15 (1): 40-48. Jan. 1976. SFA 21(4)
[Ecosystems Dep., Battelle Pac. Northwest Lab., Richland, WA 99352] These data indicate that at the experimental temperatures employed in this study, there is no additional effect of temperature upon the toxicity of chlorine to juvenile brook trout when exposed for 96 hrs at 10 or 15°C. However, at the 20°C test temperature, 96-hr LC50 values were significantly lower at the 95 percent fiducial limit. Since there were no deaths in the control chambers the combined effects of thermal alteration and chlorine exposure indicated synergism under these conditions.--From discuss. and interp.

76-001634 Till, J. E. THE TOXICITY OF URANIUM AND PLUTONIUM TO THE DEVELOPING EMBRYOS OF FISH. Ph. D. dissertation, Ga. Inst. Technol. 203p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(3), 1976. SFA 21(4)
The radiological and chemical toxicity of plutonium and uranium to the developing embryos of fish was investigated using eggs from carp, /Cyprinus carpio/, and fathead minnows, /Pimephales promelas/. Freshly fertilized eggs were developed in solutions containing high specific activity ^{238}Pu or ^{232}U or low specific activity ^{244}Pu, ^{235}U, or ^{238}U. Quantitative tests to determine the penetration of these elements through the chorion indicated that plutonium accumulated in the contents of carp eggs reaching a maximum concentration factor of approximately 3.0 at hatching. Autoradiographs of 16 u egg sections showed that plutonium was uniformly distributed in the egg volume. Uranium localized in the yolk material, and the concentration factor in the yolk sac remained constant during development at approximately 3.3. Doses from ^{238}Pu which affected hatchability of the eggs were estimated to be 1.6×10^4 rads and 9.7×10^3 rads for /C. carpio/ and /P. promelas/, respectively; doses from ^{232}U were 1.3×10^4 rads for /C. carpio/ and 2.7×10^3 rads for /P. promelas/. A greater number of abnormal larvae than in control groups was produced by ^{238}Pu doses of

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4.3 x10^3 rads to carp and 5.7 x 10^2 rads to fathead minnows; 3.2 x 10^3 rads and 2.7 x 10^2 rads were estimated from ^{232}U. Eggs that were incubated in 20 ppm ^{244}Pu did not hatch. This mortality may have been the result of chemical toxicity of plutonium. Concentrations of 60 ppm of ^{235}U and ^{238}U did not affect egg hatching. Based on these data, concentrations in fish eggs were calculated for representative concentrations of uranium and plutonium in waste waters and the corresponding dose levels are below those levels at which observable effects begin to occur.

76-001635 Tsai, S.-C. INFLUENCE OF AQUATIC ENVIRONMENTAL FACTORS ON THE UPTAKE AND TOXICITY OF MERCURIALS IN FISH. Ph. D. dissertation, Univ. Wis. (Madison) 159p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(2), 1976. SFA 21(4)

The liposolubilities of 18 mercurials, and their relative acute toxicities as well as uptake rates by fathead minnows (/Pimephales promelas/) were measured, with the aid of an atomic absorption spectrophotometer. These mercurials included 5 inorganic mercuric salts, 10 organomercuric salts, and 3 dialkyl mercuries. Those mercurials of high liposolubility were readily picked up by fish, while the low liposolubility ones were picked up slowly. The high lipid soluble members of the mercuric and organomercuric salts were more readily picked up and more toxic to fish than their analogs of low liposolubility. The water pH and chlorinity affected the partition coefficient of inorganic mercuric chloride solutions. The uptake by black bullheads (/Ictalurus melas melas/) in waters of various pH levels was parallel to partition coefficients. Both parameters were high in acidic water and low in alkaline water. The presence of sodium chloride at low concentrations (less than 600 ppm) increased the partition coefficient of the aquatic mercuric complexes, while higher chlorinity reduced the partition coefficient. In general, the uptake of inorganic mercury by rainbow trout (/Salmo gairdneri/) in water of various chlorinity levels paralleled the partition coefficient. Both the inorganic mercury and methyl mercury were more readily picked up by fish from acidic water than from alkaline water. Sodium chloride at low concentrations (less than 1,000 ppm) accelerated the uptake of inorganic mercury and methyl mercury, but reduced the uptake at higher concentrations. Similarly, sodium sulfide hydrate accelerated the uptake of methyl mercury at low concentrations (less than 0.2 ppm), while it reduced the uptake at higher concentrations. The sulfide also accelerated the uptake of inorganic mercury. It is thought that these environmental factors affect the uptake of mercury by changing the composition of the mercury complexes in water.--From abstr.

76-001636 Waggoner, J. P. III; Zeeman, M. G. DDT: SHORT TERM EFFECTS ON OSMOREGULATION IN BLACK SURFPERCH (/EMBIOTOCA JACKSONI/). Bull. Environ. Contam. Toxicol. 13 (3): 297-300. Mar. 1975. SFA 21(4)

[Dep. Biol. Sci., Univ. South. Calif., Los Angeles 90007] DDT injected intraperitoneally into black surfperch caused substantial increases in plasma osmotic concentration only at doses much larger than are likely to be encountered in nature. Increased plasma concentrations were below those tolerated by fish adapted to high salinities. Death of marine teleosts from DDT poisoning probably involves factors other than simply osmoregulatory failure.--From summ.

76-001637 Watkins, J.; Yarbrough, J. D. ALDRIN AND DIELDRIN UPTAKE IN INSECTICIDE-RESISTANT AND SUSCEPTIBLE MOSQUITOFISH (/GAMBUSIA AFFINIS/). Bull. Environ. Contam. Toxicol. 14 (6): 731-737. Dec. 1975. SFA 21(4)
[Dep. Zool., Miss. State Univ., Mississippi State 39762] Insecticide-resistant and susceptible mosquitofish (/Gambusia affinis/) were exposed to ^{14}C-aldrin and ^{14}C-dieldrin for timed intervals. Whole body and tissue levels of the two organochlorine insecticides were compared between the two populations. At the 10 ppb aldrin and dieldrin treatment levels there were no significant insecticide level differences between resistant and susceptible fish. However, at 80 ppb aldrin and 30 ppb dieldrin there was 8.5 times as much aldrin in whole body samples of susceptible fish as in whole body samples from resistant fish. There was only 1.24 times as much dieldrin in susceptible as in resistant fish, but it was significant. There were significantly higher amounts of both insecticides in tissues (muscle, liver, and brain) examined from susceptible fish, with the exception of the liver in which dieldrin levels were essentially the same for both populations. Insecticide level comparisons were also made on the basis of whether the fish were exhibiting symptoms of poisoning or not exhibiting symptoms of poisoning. Within the susceptible population there was no difference in the aldrin whole body levels between those fish not exhibiting symptoms and those exhibiting symptoms of poisoning. However, there was a higher level of dieldrin in fish exhibiting symptoms as compared to those not exhibiting symptoms. There were no differences in the insecticide levels in tissues. In comparisons between populations there were significantly higher levels in both whole body and tissue samples of susceptile fish as compared to resistant fish. This was true regardless of whether susceptible fish were exhibiting symptoms or not exhibiting symptoms of poisoning.--From abstr.

76-001638 Watson, T. A.; McKeown, B. A. THE ACTIVITY OF DELTA 5-3 BETA HYDROXYSTEROID DEHYDROGENASE ENZYME IN THE INTERRENAL TISSUE OF RAINBOW TROUT (/SALMO GAIRDNERI/ RICHARDSON) EXPOSED TO SUBLETHAL CONCENTRATIONS OF ZINC. Bull. Environ. Contam. Toxicol. 16 (2): 173-181. Aug. 1976. SFA 21(4)
[Dep. Zool., Univ Guelph, Guelph, ON, Canada] The effects of exposure of rainbow trout (/Salmo gairdneri/ Richardson) to three sublethal concentrations of zinc (0.248, 0.528 and 1.14 ppm) on delta 5-3 beta-hydroxysteroid dehydrogenase (delta 5-3 beta HSDH) enzyme activity in the head kidney tissue was investigated. The activity of this enzyme was localized by the reduction of a tetrazolium salt to formazan at the site of activity. Using subjective methods to indicate the degree of activity and indirectly assess the degree of corticosteroid production, the zinc-exposed rainbow trout showed a greater degree of delta 5-3 beta HSDH activity compared to the control fish. This increase in enzyme activity has been associated with the stimulation of the pituitary-interrenal axis by the noxious stress of zinc.

76-001639 Weis, P.; Weis, J. S. EFFECTS OF HEAVY METALS ON FIN REGENERATION IN THE KILLIFISH, /FUNDULUS HETEROCLITUS/. Bull. Environ. Contam. Toxicol. 16 (2): 197-202. Aug. 1976. SFA 21(4)
[Dep. Anat., N.J. Med. Sch., Newark 07103]

76-001640 Wright, L. D. EFFECT OF MALACHITE GREEN AND FORMALIN ON THE SURVIVAL OF LARGEMOUTH BASS EGGS AND FRY. Prog. Fish-Cult. 38 (3): 155-157. July 1976. SFA 21(4)
[U.S. FWS, Cheraw Natl. Fish Hatchery, Cheraw, SC 29520] Formalin and malachite green were tested on incubating eggs and newly hatched fry of the largemouth bass (/Micropterus salmoides/) to determine their effectiveness in controlling fungus and disease. Bass eggs could be safely treated for fungus with formalin at 4,000 ppm for 10 min; the fry could be safely treated at 50 ppm for 60 min. Malachite green proved to be extremely toxic to the eggs and fry of largemouth bass and should never be used in the culture of this species.

76-001641 Yap, H. H.; Desaiah, D.; Cutkomp, L. K.; Koch, R. B. /IN VITRO/ INHIBITION OF FISH BRAIN ATPASE ACTIVITY BY CYCIODIENE INSECTICIDES AND RELATED COMPOUNDS. Bull. Environ. Contam. Toxicol. 14 (2): 163-167. Aug. 1975. SFA 21(4)
[Sch. Biol. Sci., Univ. Sains Malaysia, Penang, Malaysia]

76-001642 Zitko, V. AROMATIC HYDROCARBONS IN AQUATIC FAUNA. Bull. Environ. Contam. Toxicol. 14 (5): 621-631. Nov. 975. SFA 21(4)
[Dep. Environ., Fish. Mar. Serv., Biol. Stn., St. Andrews, NB E0G 2X0, Canada] The detection limit of crude, Bunker C, and creosote oil in the described method is approximately 100, 50, and 100 ug/g lipid, respectively. Polynuclear aromatic hydrocarbons of these oils were not detectable in samples of fish and seals. Creoscte oil in concentrations ranging from 202 to 3254 ug/g lipid was detected in the samples of shellfish.--Concl.

76-001643 Zitko, V.; Cunningham, T. D. FISH TOXICITY OF S-METHYL FENITROTHION. Bull. Environ. Contam. Toxicol. 14 (1): 19-24. July 1975. SFA 21(4)
[Dep. Environ., Fish. Mar. Serv., Biol. Stn. St. Andrews, BC E0G 2X0, Canada] The acute toxicity of S-methyl fenitrothion to juvenile Atlantic salmon is approximately equal to that of fenitrothion. For both compounds the nominal concentration below which no mortality occurs in 96 h, is 0.63 mg/l.--Concl.

FISH TOXICANTS

76-001644 Gabica, J.; Benson, W. W.; Watson, M. A RAPID AND SENSITIVE METHOD FOR GAS CHROMATOGRAPHIC ANALYSIS OF THE SELECTIVE PISCICIDE, "SQUAXON". Bull. Environ. Contam. Toxicol. 15 (2): 155-161. Feb. 1976. SFA 21(4)
[Idaho Epidemiol. Stud. Proj., Dep. Health Welfare, Statehouse, Boise 83720] "Squaxon" exhibits piscicidal properties that are highly species specific. The chemical is lethal to the Northern (/Ptychocheilus oregonensis/) and the Umpqua (/P. umpquae/) squawfish, freshwater cyprinids common to the Pacific Northwest, at water treatment concentrations of less than 100 parts per billion (ppb). Other species of fish, including the more desirable salmonids with which the squawfish competes ecologically, are unaffected until this dosage has been increased severalfold. Because squawfish are widely regarded as undesirable for food or sporting purposes, and because competition from squawfish has severely depleted salmonid populations in some areas the potential use of squaxon for fisheries improvement is quite obvious. Squaxon is currently being tested for this purpose on an experimental basis in selected areas in Idaho, Oregon and

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Washington, pending federal clearance for more widespread application. Commercially formulated squaxon currently being field tested is despersed as an ethanolic solution of the monosodium salt. We report here an analytical method by which petroleum ether-extracted, brominated squaxon can be quickly and easily detected in water and fish tissue by electron capture gas chromatography.--From abstr.

76-001645 Schaper, R. A.; Crowder, L. A. UPTAKE OF ^{36}CL-TOXAPHENE IN MOSQUITO FISH, /GAMBUSIA AFFINIS/. Bull. Environ. Contam. Toxicol. 15 (5): 581-587. May 1976. SFA 21(4)
[Dep. Entomol., Univ. Ariz., Tucson 85721] The toxicity syndrome of toxaphene to /G. affinis/ was divided into 5 stages, and the residue level at each stage was determined. By the time fish were exhibiting the first toxicity response (state 2), 90.3 percent of the mean fatal residue level had been sorbed. Regression analysis indicated that sorption of toxaphene is a linear function with respect to time. Excretion was not observed following an 8 hour exposure to 2ppm toxaphene. Metabolic alteration of toxaphene during the experiments appeared to be minimal. Differences in individual mortality appeared to be due to differences in uptake rather than differences in ability to tolerate particular body loads of toxaphene.--Summ.

76-001646 Sills, J. B.; Allen, J. L. RESIDUES OF 3-TRIFLUOROMETHYL-4-NITROPHENOL (TFM) UNDETECTED IN LAKE TROUT AND CHINOOK SALMON FROM THE UPPER GREAT LAKES. Prog. Fish-Cult. 38 (4): 197. Oct. 1976. SFA 21(4).
[U.S. FWS, Southeast. Fish Control Lab., Warm Springs, GA 31830] Muscle tissue samples from 51 lake trout (/Salvelinus namaycush/) and 26 chinook salmon (/Oncorhynchus tshawytscha/) collected in 1973 from Lakes Superior, Michigan, or Huron were analyzed for 3-trifluoromethyl-4-nitrophenol (TFM), a larvicide used in Lake Superior tributaries since 1958 for control of the sea lamprey (/Petromyzon marinus/). No residues (detection limit, less than 0.01 ug/g) of TFM were found in any of the samples analyzed.

RESEARCH AND MANAGEMENT-GENERAL

76-001647 Peshkevich, A. N.; Votinov, N. P.; Koz'min, Yu. A.; Rizvanov, R. A; Siginevich, G. P.; Polymskiy, V. N.; Zamyatin, V. A.; Noreyko, D. S. COMPOSITION OF STOCKS AND REPRODUCTION OF COMMERCIAL FISHES IN WATERS OF SIBERIA AND THE URAL. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (3): 360-373. 1975. SFA 21(4)
[SibNIIRKh, USSR] The waters and ichthyofauna of Siberia and the Ural are described. The importance of river, lake and reservoir fish catch, the dynamics of catches by region, the present composition of fish stocks and improvements through fish propagation programs are considered.

REPORTS OF FISHERY STATIONS, STATES, ETC.

76-001648 Bittern, D. , (ed.) 34TH ANNUAL REPORT OF THE ATLANTIC STATES MARINE FISHERIES COMMISSION. Atl. States Mar. Fish. Comm., Washington, D.C. iii + 40p. 1976. SFA 21(4)
[Atlantic States Mar. Fish. Comm., 1717 Massachusetts Ave, N.W., Washington, DC 20036]

76-001649 Kennelly, J. J.; Applegate, R. L. COOPERATIVE RESEARCH UNITS, FISHERY AND WILDLIFE, ANNUAL REPORT 1974-75. U.S. Dep. Interior, Fish Wildl. Serv. iii + 251p. 1976. SFA 21(4).
[U.S. FWS, Washington, D.C. 20240]

HABITAT ALTERATION

76-001650 Bennett, D. H. EFFECTS OF PUMPED STORAGE PROJECT OPERATIONS ON THE SPAWNING SUCCESS OF CENTRARCHID FISHES IN LEESVILLE LAKE, VIRGINIA. Ph. D. dissertation, Va. Polytech Inst. & State Univ. 151p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(2), 1976. SFA 21(4)
Hydroelectric power generation operations at the Smith Mountain Dam power plant create high water velocities with daily flow reversals, and water level and temperature fluctuations in Leesville Lake. Generaly, gonadal maturation and the presence of fish in spawning condition occurred earlist in the warmer lower zone, later in the mid reservoir, and last in the cooler upper zone of Leesville Lake during 1972 and 1974. During 1974, trained divers located and inspected 2010 centrarchid fish spawning nests in Leesville Lake. Based on a constant unit of diving effort, 40 percent of nests occurred in lower Leesville, 57 percent in mid, and about 3 percent in the upper reservoir zone. High water velocities restricted spawning activity in the mid and upper reservoir zones almost entirely to cove areas. Water velocities in lower Leesville had negligible effects on the distribution of spawning activity. A stepwise regression model indicated that water velocities during power generation at Smith Mountain Dam was the single most important factor affecting the distribution of spawning nests in the main lake. Vertical distribution of centrarchid fish spawning nests suggested that adjustment to the spawning depth had occurred in response to the fluctuation in water levels. Laboratory and field studies were conducted to evaluate hatching success of bluegill eggs under controlled water temperatures and exposures to air. Average hatching success increased as hatching temperature increased from 16 to 28 C. Based on the current levels of exploitation, natural spawning success of largemouth bass and bluegill in Leesville Lake appears adequate to maintain the densities of these centrarchid fish stocks.--From abstr.

76-001651 Butschek, V.; Lillelund, K.; Mann, H.; Scheer, G. EMPFEHLUNGEN ZUR ERSTELLUNG VON GUTACHTEN BEI FISCHEREISCHAEDEN. [RECOMMENDATIONS FOR EXPERTISES ON DAMAGES REGARDING TO FRESH-WATER FISHERIES.] Arch. Fischereiwiss. 26 (Suppl. 1): 1-34. Aug. 1975. In German with English Preface. SFA 21(4)
Due to growing human population and the wish for an increasing living standard our living space has been industrialized more and more, navigable waterways have been constructed by using natural waters; rivers and brooks have been regulated and straightened. Most waters in industrial countries are more or less polluted by waste water. Altogether many environmental factors changed and influenced

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the ecosystem in our waters. Consequently fishes and fisheries are threatened by many events and very often great damages to the fisheries follow. These damages can only be judged by well trained specialists who have an expert knowledge on the very complex relationship between the natural environment and the productivity for fisheries. For such a judgement a great number of biological and economical factors have to be taken into consideration. This contribution shall help to formulate an expertise on fisheries damage and attention has been drawn to some important points of view on the different types of damages. In addition a model for a high, a medium and a low fisheries intensity has been given to calculate the number of fry, fingerlings or yearlings if a water has to be restocked. As the natural conditions normally differ more or less from the model, factors for corrections are introduced. The calculation has been demonstrated by example.--Preface.

76-001652 Fast, A. W.; Lorenzen, M. W.; Harlan, G. J. COMPARATIVE STUDY WITH COSTS OF HYPOLIMNETIC AERATION. Proc. Am. Soc. Civ. Eng., J. Environ. Eng. Div. 102 (EE6): 1175-1187. Dec. 1976. SFA 21(4).
[Limnological Assoc., Ojai, CA] Hypolimnetic aeration/oxygenation is a means of thermal stratification maintenance and oxygenation of hypolimnetic waters in a lake or reservoir. The process differs from destratification, where the objective is reduction or elimination of thermal stratification and oxygenation of the bottom waters. Hypolimnetic aeration/oxygenation greatly improves domestic and industrial water quality, satisfies downstream water release standards, creates suitable habitat for yearlong survival of coldwater fish, and otherwise benefits the environment. Methods of hypolimnetic aeration/oxygenation which use pure oxygen, a partial air lift pump and a full air lift pump are described and analyzed. Cost estimates for these systems at San Vicente Reservoir, California reveal that the full air lift design is substantially more efficient and less costly to operate.

76-001653 Fast, A. W.; Lorenzen, M. W. SYNOPTIC SURVEY OF HYPOLIMNETIC AERATION. Proc. Am. Soc. Civ. Eng., J. Environ. Eng. Div. 102 (EE6): 1161-1173. Dec. 1976. SFA 21(4).
[Limnological Assoc. Ojai, CA] Hypolimnetic aeration/oxygenation is a means whereby thermal stratification can be maintained in a lake or reservoir and the hypolimnetic waters are oxygenated. Seventeen different hypolimnetic aerator/oxygenator designs are presented and analyzed, categorized as mechanical agitation systems, pure oxygen injection systems, and air injection systems. Air injection systems can be further subdivided into full air lift designs, partial air lift designs and downflow air injection. Of all the systems, the full air lift is probably the most efficient in terms of energy consumed to dissolve a given amount of oxygen. None are in widespread usage.

76-001654 Garton, J. E.; Jarrell, H. R. DEMONSTRATION OF WATER QUALITY ENHANCEMENT THROUGH THE USE OF THE GARTON PUMP. Okla. Water Resour. Res. Inst. Tech. Compl. Rep. Proj. C-5228 (suppl.). 21p. 1976. SFA 21(4)
[Okla. State Univ., Stillwater 74074] The report discusses a recent demonstration on the use of a small Garton Pump to alleviate water quality problems associated with the low level release of water from a stratified reservoir.--RS

76-001655 Gebhart, G. E.; Summerfelt, R. C. EFFECTS OF DESTRATIFICATION ON DEPTH DISTRIBUTION OF FISH. Proc. Am. Soc. Civ. Eng., J. Environ. Eng. Div. 102 (EE6): 1215-1228. Dec. 1976. SFA 21(4)

[Okla. Coop. Fish. Res. Unit, Okla. State Univ., Stillwater] The writers' observations in Lake of the Arbuckles, Oklahoma, in 1973-1975 indicate that depth distributions of gizzard shad, white crappie, freshwater drum, and black bullhead were markedly affected by conditions of stratification. During stratification the distribution of all species except the bullhead was limited largely to oxygenated water above the hypolimnion. Fish depth distribution increased substantially after the fall overturn. Operation of an axial flow pump in the summers of 1974-1975 appeared to cause turnover 1 month earlier than shown by the writers for 1973, and data of other workers for 1969-1970.

76-001656 Golden, M. P.; Twilley, C. E. FISHERIES INVESTIGATION OF A CHANNELIZED STREAM, BIG MUDDY CREEK WATERSHED, KENTUCKY. Trans. Ky. Acad. Sci. 37 (3-4): 85-90. Sept. 1976. SFA 21(4)

[Dames & Moore, Environmental Consultants, 1150 W. 8th St., Cincinnati, OH 45203] This preliminary survey was undertaken to broaden the data base on the fishes of the Big Muddy Creek watershed, Butler and Logan counties, Kentucky. Fish collections and water quality characteristics are reported for 4 stations in the watershed for August 1974. Thirty-one species of fishes were collected during the survey, bringing the total kinds of fishes known from the Big Muddy Creek drainage to 40. Biomass and number of species were reduced significantly in channelized areas as compared to unchannelized areas. This indicates full recovery has still not occurred after 33 years, since the last channel maintenance was completed in 1941. Water quality was generally within acceptable limits established by the state of Kentucky for all sampling stations. Therefore, habitat alteration is the likely cause for the reductions in fish diversity and biomass.

76-001657 Grobey, J. H. AN ALTERNATIVE PUBLIC POLICY FOR REGULATING THE IMPACT OF FOREST PRACTICES ON THE NORTHERN CALIFORNIA SALMONID FISHERY. Ph. D. dissertation, Univ. Wash. 145p. 1975. From Diss. Abstr. Int. B Sci. Eng. 37(2), 1976. SFA 21(4)

The present study is intended to provide a better understanding of the relationship between salmonid fisheries and forest practices in the northern California region to indicate an alternative form of public policy for regulating forest practices in the interest of economic efficiency. The paper presents a model of the interdependence of forest practices and fishery resources in the abstract context of the economic theory of externality. The externality literature is examined to reveal the efficiency distortion generated by this condition, and the range of corrective policies available. Both efficiency and equity effects of policy are considered. The investigation reveals the practical impossibility of specifying a model in which parameters of the control variables on logging practices affecting salmon yield functions can be statistically estimated. The implications of these difficulties for policy formation are examined in relation to the range of possible policy prescriptions for correcting the externality condition. Finally, taxes and subsidies, or fees and payments based on a system of merit and penalty points are recommended as an alternative to direct regulation of forest practices.--From abstr.

76-001658 Haynes, R. C. SOME ECOLOGICAL EFFECTS OF ARTIFICIAL CIRCULATION ON A SMALL EUTROPHIC LAKE WITH PARTICULAR EMPHASIS ON PHYTOPLANKTON II. KEZAR LAKE EXPERIMENT, 1969. Hydrobiologia 46 (1): 141-170. Feb. 1975. SFA 21(4)

[Nat. Sci., Sangoman State Univ., Shepherd Rd., Springfield, IL 62708] A small eutrophic New Hampshire lake was artificially circulated (mixed) from 28 May to 15 September, 1969, inclusive, to impede the annual bloom of a noxious blue-green algae; yet /Aphanizomenon flos-aquae/ bloomed immediately after mixing was commenced. The bloom collapsed in early July; it was succeeded by heavy growth of predominantly chlorophycean taxa. In an /in vitro/ experiment /Aphanizomenon flos-aquae/ did reattain bloom proportions when the influence of artificial circulation was removed. Other phytoplankton exhibited population pulses only when the dominance of cyanophycean and chlorophycean taxa were in transition. Mixing maintained uniform vertical populations of all phytoplankton. Changes in water transparency attended fluctuations in phytoplankton abundance. An isothermic condition was maintained over the test period, which increased the lake's heat budget, and most chemical nutrients were distributed isometrically in the water column. Increased concentrations were exhibited by Ca, Cl, Cu, K, Mg, SiO(2) and Zn. Sodium was not affected by mixing. Levels of Fe, Mn, Zn, phosphate and ammonia, nitrate, and organic nitrogen were influenced by phytoplankton. Mixing could not maintain orthograde profiles of dissolved O(2) and CO(2) when dense populations of phytoplankton prevailed. Variations in chlorophyll-a followed closely changes in phytoplankton abundance. Its degradation to phec-pigments appeared to be less for a bloom of /Aphanizomenon flos-aquae/ than during dense growth of chlorophycean taxa. Rates of photosynthesis were considerably greater when the latter algae were predominant. Extracellular release of organic carbon usually increased with depth; it amounted to 19.4 percent of the total carbon fixed in the euphotic zone.

76-001659 LaBounty, J. F.; Crysdale, R. A.; Eller, D. W. DIVE STUDIES AT TWIN LAKES, COLORADO 1974-75. U.S. Dep. Int., Bur. Reclam. REC-ERC-76-15. ii + 23p. Sept. 1976. SFA 21(4).

[Bur. Reclamation, Eng. Res. Cent., Denver, CO] The Bureau of Reclamation is constructing the 200-MW Mt. Elbert Pumped-Storage Powerplant on the north shore of Twin Lakes, Colo., and enlarging the two lakes to serve as the powerplant afterbay. As part of the ongoing ecological study of Twin Lakes, three separate SCUBA dives were made in June and August of 1974 and June 1975. The objective of the dives was to obtain a qualitative perspective which will contribute to existing quantitative data providing a comprehensive base of information on the lakes' aquatic environment. As a result, when the powerplant begins operation and the lakes are enlarged, the impacts can be completely evaluated. The shallower eulittoral areas of both lakes contain numerous rocks. The north shore of the lower lake has particularly large rocks which are ideal lake trout spawning areas. Aquatic plants are more abundant in the lower lake at depths to 10.7 m. Aquatic plants were found to depths of 3 m in the upper lake and 14 m in the lower lake. Pondweed, which is abundant in the lower lake, was not observed in the upper lake. Mysis shrimp were observed universally in both lakes in densities of about 200/m^2. A high of 500 to 600 shrimp/m^2 was observed near the powerplant tailrace in August 1975. Suckers were the most commonly observed species of fish; however, lake trout, rainbow trout, and smelt were also observed. Lake trout fry in densities up to 200/m^2 were observed at depths of 20 m near the pumping plant.

76-001660 Moyle, P. B. SOME EFFECTS OF CHANNELIZATION ON THE FISHES AND INVERTEBRATES OF RUSH CREEK, MODOC COUNTY, CALIFORNIA. Calif. Fish Game 62 (3): 179-186. July 1976. SFA 21(4).
[Div. Wildl. Fish Biol., Univ. Calif., Davis 95616] Channelized and unchannelized sections of the lower 7 km (4.3 miles) of Rush Creek, Modoc County, California were compared to determine the impact of channelization on fish populations, especially those of trcut (/Salmo gairdneri/ and /S. trutta/) and the rare endemic Modoc sucker (/Catostomus microps/), and invertebrate populations. Fish were captured with a backpack electrofisher, which provided a representative sample by numbers of the species present, although large fish were more vulnerable to capture than small fish. Channelized sections contained fewer and smaller trout, as well as a lower biomass, than the unchannelized sections. Modoc sucker numbers and biomass were also lower in the channelized sections. Only Pit sculpin (/Cottus pitensis/) were consistently more numerous in the channelized sections. Overall, total fish biomass in the channelized sections was less than one-third of that in the unchannelized sections. The biomass of invertebrates in the channelized sections was found to be less than one-third of that in the unchannelized sections. The invertebrate species composition of the two areas was also different.

76-001661 Pearson, R. G.; Jones, N. V. THE EFFECTS OF DREDGING OPERATIONS ON THE BENTHIC COMMUNITY OF A CHALK STREAM. Biol. Conserv. 8 (4): 273-278. Dec. 1975. SFA 21(4)
[Zool. Dep., James Cook Univ. N. Queensland, Queensland 4811, Austrilia] Sampling of the benthic fauna showed that dredging operations produced relatively short-term effects on invertebrate population levels. The behavicur of the animals was immediately affected, the differences between species were noted and the implications of dredging at different times of year are discussed.

76-001662 Stickney, R. R.; Perlmutter, D. IMPACT OF INTRACOASTAL WATERWAY MAINTENANCE DREDGING ON A MUD BOTTOM BENTHOS COMMUNITY. Biol. Conserv. 7 (3): 211-226. Apr. 1975. SFA 21(4)
[Skidaway Inst. Oceanogr., P.O. Box 13687, Savannah, GA 31406] The effects of hydraulic dredging on the benthic infauna of a mud bottom area were investigated in Georgia in the Atlantic Intracoastal Waterway. Complete displacement of the benthic community was caused by dredging; however, the community began to recover within a month following the cessation of dredging. Within two months the diversity and species composition of the dredged channel were similar to that of a control area and little change in sediment composition resulted. Thus, no apparent limitation was imposed on the normal benthic population by habitat alteration. Recolonisation was too rapid to have been caused by the settling of immature or larval stages from the water column alone. Bank slumping and migration of adult forms have been postulated as other means of recolonisation.

76-001663 Ward, J. V. COMPARATIVE LIMNOLOGY OF DIFFERENTIALLY REGULATED SECTIONS OF A COLORADO MOUNTAIN RIVER. Arch. Hydrobiol. 78 (3): 319-342. Sept. 1976. In English with German summ. SFA 21(4)
[Dep. Zool. Entomol., Colo. State Univ., Fort Collins, 80523] Studies of one-year duration were conducted from 1972-75 on four sections of the South Platte River in the Colorado mountains to elucidate the effects and extent of influence of deep release dams on stream macroinvertebrates. Study sites represented a gradient from highly regulated to unregulated by dams. Macroinvertebrates exhibited lower standing crops but much higher diversity at unregulated sites.

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/Gammarus/ and gastropods were restricted to regulated sites, whereas filipalpian stoneflies, heptageniid mayflies, and certain dipterans were not found below the dam. Restriction of taxa to regulated or unregulated sites is explained by differences in (1) chemical limiting factors, (2) distribution and abundance of submerged angiosperms and epilithic algae, (3) diversity of organic matter inputs, (4) predation pressure and competitive interactions, (5) environmental stability and predictability, and (6) thermal signals.

HARVEST, CREEL CENSUS

76-001664 Carpenter, M. R.; Bowlus, D. R. ATTITUDES TOWARD FISHING AND FISHERIES MANAGEMENT OF USERS IN DESOLATION WILDERNESS, CALIFORNIA. Calif. Fish Game 62 (3): 168-178. July 1976. SFA 21(4).
[Calif. Dep. Fish Game, Sacramento] Users of Desolation Wilderness sampled from a list of wilderness area permittees were surveyed to determine their attitudes towards the fish resources and the fisheries management policies in the Desclation Wilderness. Although only a small proportion came to the Area primarily tc fish, 40 percent of the respondents brought fishing gear. The present fisheries management policies were supported by 68 percent of those surveyed; only 13 percent of the respondents held negative attitudes about these programs.

MARKING AND TAGGING

76-001665 Jones, B. C.; Geen, G. H. MARKING ELASMOBRANCHS BY FREEZE-BRANDING. Prog. Fish-Cult. 38 (4): 179. Oct. 1976. SFA 21(4)

[Dep. Biol. Sci., Simon Frazer Univ., Burnaby, BC V5A 1S6, Canada] A method of marking elasmobranchs by freeze-branding with liquid nitrogen is described. Numbers 2 cm high applied for 5 s were readily visible for 1 year.

76-001666 Moring, J. R.; Moring, K. A. COMPARISONS OF RETURNS OF COLOR-CODED WIRE HEAD TAGS AND ANCHOR TAGS IN DELAYED-RELEASE CHINOOK SALMON. Prog. Fish-Cult. 38 (4): 200-202. Oct. 1976. SFA 21(4).
[Oreg. Dep. Fish Wildl., Oreg. State Univ., Corvallis 97331] Delayed releases of 24,527 immature chinook salmon (/Oncorhynchus tshawytscha/) were made from floating pens at four locations in Puget Sound, Washington, in late 1971 and early 1972. All were marked with color-coded wire head tags, and 1,281 were also marked with colored Floy anchor tags. Movements and recoveries of these fish were monitored for 2 years after release. A total of 378 tagged fish were recovered during the 2-yr period--361 with wire head tags and 17 with anchor tags. Proportional differences in these returns were not significant at the 95 percent confidence level; however, the wire head tags provided more information on recaptures and fish movements.

76-001667 Rinne, J. N. CODED SPINE CLIPPING TO IDENTIFY INDIVIDUALS OF THE SPINY-RAYED FISH /TILAPIA/. J. Fish. Res. Board Can. 33 (11): 2626-2629. Nov. 1976. In English with French summ. SFA 21(4).
[Rocky Mtn. Forest Range Exp. Stn., ASU, Tempe, AZ 85281] Clipping 1 or more spines in the dorsal and anal fins was used to identify individual /Tilapia/. In fish greater than 15 cm the mark was permanent. In smaller fish spine regeneration occurred, but clipped spines could be recognized both by their incomplete regrowth and abnormal appearance. This technique is applicable not only to experimental situations requiring recognition of individuals but also to group marking and to other Perciforms.

76-001668 White, L. E. FLUORESCENT PIGMENT RETENTION BY PINK SALMON MARKED AS SCALELESS FRY. Prog. Fish-Cult. 38 (4): 184-186. Oct. 1976. SFA 21(4).
[Alaska Dep. Fish Game, Kodiak 99615] In 1974 and 1975, scaleless fry of pink salmon (/Oncorhynchus gorbuscha/) were sprayed with pigment and held for observation in a mark-retention experiment. In 1974, fish were sprayed at 13.2 kg/cm² (90 psi) with a 45.4-liter air compressor. The percentages that retained the pigment after 2, 25, 99, 132 and 218 days were 92.0, 71.0, 57.5, 55.0 and 35.2, respectively. In 1975, fry were sprayed at 14.7 kg/cm² (100 psi) with a 5.7 m³ air cylinder. The percentages that retained the mark after 3, 8, 37, 172-189 and 203 days were 97.5, 33.0, 78.0, 61.3 and 50.0, respectively. The progressive loss of pigment with time indicated that this technique is not suitable for long-term marking studies and should by used only judiciously in short-term studies.

STOCKING AND INTRODUCTIONS

76-001669 Courtenay, W. R.; Robins, C. R. EXOTIC ORGANISMS: AN UNSOLVED, COMPLEX PROBLEM. Bioscience 25 (5): 306-313. May 1975. SFA 21(4)
[Dep. Biol. Sci., Fla. Atl. Univ., Boca Raton 33432]

76-001670 Glucksman, J.; West, G.; Berra, T. M. THE INTRODUCED FISHES OF PAPUA NEW GUINEA WITH SPECIAL REFERENCE TO /TILAPIA MOSSAMBICA/. Biol. Conserv. 9 (1): 37-44. Jan. 1976. SFA 21(4)
[Dep. Agric. Stocks Fish., Res. Stn., Kanudi, Port Moresby, Papua New Guinea] Twenty-one species of freshwater fishes in 19 genera (/Salmo, Salvelinus, Retropinna, Barbus, Ctenopharyngodon, Cyprinus, Hypophthalmichthys, Puntius, Tandanus, Gambusia, Poecilia, Percolates, Plectroplites, Bidyanus, Tilapia, Trachystoma, Hypseleotris, Osphronemus/ and /Trichogaster/) representing 11 families and all six continental regions have been introduced into Papua New Guinea. A list of species, date of first introduction, distribution and comments are presented. The dispersal of /Tilapia mossambica/ on Bouganville Island from a single introduction followed by floods and human transport is discussed.

76-001671 Moyle, P. B. FISH INTRODUCTIONS IN CALIFORNIA: HISTORY AND IMPACT ON NATIVE FISHES. Biol. Conserv. 9 (2): 101-118. Feb. 1976. SFA 21(4)

[Div. Wildl. Fish. Biol., Univ. Calif., Davis 95616] Since 1871, at least 50 species of fish have been successfully introduced into California's inland waters, and numerous transfers of native fishes have been made between isolated drainage systems. Introductions were made of sport fish, commercial fish, forage fish, bait fish, fish for weed and insect control, and aquarium fish. Most of the introductions were authorised, reflecting a dissatisfaction with the native fishes, but in recent years unauthorised introductions have become common. The continuing decline of the native fish fauna seems to be largely the result of habitat change but introduced fishes may have contributed to this decline through competition, predation, and hybridisation. The lack of information on the native and introduced fishes of California, and their interactions, demonstrates the critical need for a statewide natural history survey.

76-001672 Spangler, G. R.; Berst, A. H. PERFORMANCE OF LAKE TROUT (/SALVELINUS NAMAYCUSH/) BACKCROSSES, F(1) SPLAKE (/S. FONTINALIS/ X /S. NAMAYCUSH/), AND LAKE TROUT IN LAKE HURON. J. Fish. Res. Board Can. 33 (11): 2402-2407. Nov. 1976. In English with French summ. SFA 21(4).

[Ont. Minist. Nat. Resour., Fish. Res. Stn., Tehkummah, ON P0P 2C0, Canada] This paper presents the results of plantings in Lake Huron waters of lake trout (/Salvelinus namaycush/), F(1) splake (/S. fontinalis/ X /S. namaycush/), and the progeny of the backcross between splake males and lake trout females. The planted fish were piscivorous throughout age-groups II-V with rainbow smelt (/Osmerus mordax/), sticklebacks (/Pungitius/ [?]), and alewives (/Alosa pseudoharengus/) the dominant food organisms. Hybrid stocks grew more rapidly but attained a somewhat smaller asymptotic length than did lake trout. The F(1) hybrids were the earliest to mature with 34 percent of the males and 4 percent of the females spawning at age II. Earliest maturity occurred in the backcrosses at age III, in contrast to lake trout which matured predominantly at ages VI and VII. The backcrosses demonstrated a slightly broader thermal and bathymetric distribution during summer than did lake trout, while the F(1) hybrids tended to concentrate in the thermocline. Total annual mortality rates (attributed mostly to predation by sea lampreys, /Petromyzon marinus/) ranged from 62 to 95 percent for all of the planted stocks.

FISHING GEAR AND TECHNIQUES

76-001673 Otobo, F. O. THE EVALUATION OF THE BEACH SEINE AS A FISHING GEAR FOR /TILAPIA/ HARVEST IN KAINJI LAKE, NIGERIA. Arch. Hydrobiol. 78 (3): 375-382. Sept. 1976. In English with German summ. SFA 21(4)

[Kainji Lake Res. Proj., New Bussa, P.M.B. 666, Kwara State, Nigeria] Preliminary fishing trials were carried out using a beach seine net for the harvest of /Tilapia/ spp. The results obtained show that this method may give very high yields of fish in Lake Kainji. Species composition analysis of the catch was compared with that obtained from experimental multifilament gillnet samples. /Tilapia/ spp. constituted 84 percent by number and 81.4 percent by weight of the catches and the dominant species was /Tilapia galilaea/ Artedi. The families Citharinidae, Characidae and Centropomidae were also represented. The high percentage of /Tilapia/ in the catch was considered very significant in view of the fact that the Cichlidae

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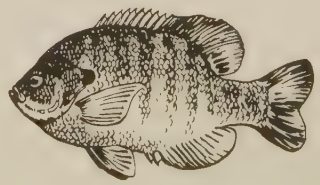
formed only a very small component of the experimental gillnet catches, never more than 1 percent by number and 2 percent by weight. It was concluded that the low percentage of cichlids in gillnet catches tend to reflect the inadequacy of this sampling method rather than the abundance and status of the Cichlidae in the lake. It was suggested that the beach seine could be used quite effectively as a fishing gear for harvesting /Tilapia/ spp. in Lake Kainji provided capital is spent on clearing of beaches in selected portions of the lake.

76-001674 Peduzzi, R.; Meng, H. INTRODUZIONE ALLA PESCA ELETTRICA. [INTRODUCTION TO ELECTROFISHING.] Riv. It. Piscic. Ittiop. 11 (3): 81-87. July-Aug.-Sept. 1976. In Italian with English summ. SFA 21(4).
[EWAG, Scuale Politecniche Federali Secione di Ricerche ittiche. CH-8600 Dubendorf, Switzerland] In this section, special stress is layed on practical aspects of electrcfishing, such as conductivity of different bodies of water; characteristics of electrodes; performances of different electrical units.--Summ.

FERTILIZATION OF WATER AND SOIL

76-001675 Boyd, C. E. WATER CHEMISTRY AND PLANKTON IN UNFERTILIZED PONDS IN PASTURES AND IN WOODS. Trans. Am. Fish. Soc. 105 (5): 634-636. Sept. 1976. SFA 21(4).
[Dep. Fish. Allied Aquacult., Auburn Univ. Agric. Exp. Stn., Auburn, AL 36830] Unfertilized ponds in pastures are more eutrophic than unfertilized ponds in woods. Fertilizer application rates currently used in bass-sunfish ponds in the southeastern United States may be greatly reduced in many pasture ponds.

76-001676 Dobbins, D. A.; Boyd, C. E. PHOSPHORUS AND POTASSIUM FERTILIZATION OF SUNFISH PONDS. Trans. Am. Fish. Soc. 105 (4): 536-540. July 1976. SFA 21(4).
[Dep. Fish. Allied Aquacult., Auburn Univ. Agric. Exp. Stn., Auburn, AL 36830] The rate of fertilization with P(2)O(5), 9 kg/hectare/application, currently recommended for woodland ponds stocked with largemouth bass and sunfish was reduced by one-half without significant reduction in sunfish production. Although further experiments need to be conducted with combinations of largemouth bass and sunfish, these results may be applied on a trial basis. Ponds with waters softer than 20 mg/liter total alkalinity and bottom muds more acid than pH 5.8 should be limed if P(2)O(5) application rates are reduced to 4.5 kg/hectare. Results of the present study probably will not apply to pasture ponds, which usually are more eutrophic than ponds on wooded watersheds. Potash apparently can be omitted from pond fertilizers without reduction in fish production, although this practice is not suggested for waters with less than 1.3 mg/liter potassium.



MATHEMATICS, STATISTICAL METHODS AND MODELING

76-001677 Jester, D. B., Jr.; Lackey, R. T. TOWARD A GENERAL MODEL OF LARGEMOUTH BASS POPULATION DYNAMICS. Va. J. Sci. 7 (2): 45. 1976. Abstract only. SFA 21(4)

[Dep. Fish. Wildl. Sci., VPI & SU, Blacksburg, VA 24061] Population models generally ignore most variation in characteristics of individuals in the population and all population structure other than age and sex. Descriptions of population processes are usually time-independent rate functions. Such models are used successfully to describe populations of organisms with simple life histories living in stable environments. A new framework is necessary to describe largemouth bass population dynamics because bass have a complex life history and live in variable environments. The new model explains changes in population structure in terms of changes in the characteristics of individuals as well as births and deaths. These processes are functions of the characteristics of the individuals involved, the structure of the population, and time-dependent environmental conditions. Several management concepts related to population structure are derived from the model by verbal argument.

LAKE MANAGEMENT & RESEARCH

76-001678 Melack, J. M. PRIMARY PRODUCTIVITY AND FISH YIELDS IN TROPICAL LAKES. Trans. Am. Fish. Soc. 105 (5): 575-580. Sept. 1976. SFA 21(4).

[Dep. Zool., Duke Univ., Durham, NC 27706] Measurements of primary productivity can improve assessment of the fish yields from tropical lakes. In tropical African and Indian lakes, commercial fish yields increase logarithmically as primary productivity increases arithmetically. The regression equation describing the relation between fish yields (/FY/) and gross photosynthesis (/PG/) for eight African lakes is log /FY/ = 0.113 /PG/ + 0.91. The coefficient of determination is 0.57. The regression equation based on fifteen tropical Indian lakes, log /FY/ = 0.122 /PG/ + 0.95, corroborates the relation for Africa.

76-001679 Stuart, S. A.; McFeters, G. A.; Schillinger, J. E.; Stuart, D. G. AQUATIC INDICATOR BACTERIA IN THE HIGH ALPINE ZONE. Appl. Environ. Microbiol. 31 (2): 163-167. Feb 1976. SFA 21(4)

[Microbiol. Dep., Mont. State Univ., Bozeman 59715] Selected waters from the high alpine zone within Grand Teton National Park, Wyoming, were analyzed for populations of indicator bacteria during the past three summers to determine the influence of various factors on the quality of these waters. In general the water quality was not significantly influenced by the presence or absence of human visitors but rather by the nature of the biological community through which the streams flowed. A minority of the coliforms that were recovered from all of the sites proved to be fecal coliforms. The fecal streptococci isolated were identified as the species that were found primarily in the fecal material of the native rodent and moose populations. It is concluded that management questions that relate to the carrying capacity of alpine areas should be approached with the aid of other biological parameters along with levels of indicator bacteria in the streams.

LARGE IMPOUNDMENT MANAGEMENT & RESEARCH

76-001680 Davies, B. R.; Hall, A.; Jackson, P. B. N. SOME ECOLOGICAL ASPECTS OF THE CABORA BASSA DAM. Biol. Conserv. 8 (3): 189-201. Nov. 1975. SFA 21(4)

[Inst. Freshwater Stud., Rhodes Univ., Grahamstown, Cape Province, South Africa] Man-made lakes are fast multiplying, particularly on the developing continent of Africa. The latest, Lake Cabora Bassa on the Middle Zambezi, began to fill on 5 December 1974 and is expected to produce electricity by September 1975. As with all new large reservoirs, the formidable engineering problems have been overcome at great cost. However, little attention has been paid to the consequences of the barrage on the valley ecosystem. Some of the major ecological problems, such as aquatic infestant macrophytes, effects on man in terms of health and welfare and the effects on the river downstream from the dam, are discussed. If care is taken to set up a dialogue between engineer and ecologist, then some of the problems can be avoided or at least foreseen. There is a great need for conservation legislation in order to protect certain elements of the Zambezi ecosystem in Mocambique from over-exploitation and ignorance. Wise conservation management--setting up of game parks and reserves, management of tourism, fishing restrictions, etc.--must be brought into effect /ab initio/ if the full potential of Lake Cabora Bassa is to be realised and safeguarded. With sparing use of such legislation, Cabora Bassa could become one of the most important resources in the development of Mocambique.

76-001681 Loeffelman, P. H.; Buikema, A. L., Jr. EFFECT OF PUMPED-STORAGE OPERATION ON SEASONAL VARIATIONS OF ZOOPLANKTON POPULATIONS. Va. J. Sci. 27 (2): 47. 1976. Abstract only. SFA 21(4)

[VPI & SU, Blacksburg, VA 24061] Zooplankton samples were collected from 4 sites on Smith Mountain Reservoir, Va., a pumped-storage impoundment. Samples were collected once a month for one year. The effect of the operation was examined on the rotifers /Keratella cochlearis/, /Polyarthra vulgaris/, /Hexarthra intermedia/, and /Conochilus dossuarius/. For the rotifers, especially /H. intermedia/, pumpback operations increased the vertical distribution of animals in the water column. This effect was most marked near the dam and may be due to the combination of turbulence and warmer temperatures at lower depths. Generally the rotifer densities near the dam were greater than those at the reference site. Possible reasons for the increase in rotifer densities include: 1) accumulation of stunned and moribund animals; 2) nutrient accumulation and increased food production; 3) warmer temperatures at lower depths; and 4) the effect of widely fluctuating temperatures on reproduction.

MARINE MANAGEMENT & RESEARCH

76-001682 Hoag, S. H. THE EFFECT OF TRAWLING ON THE SETLINE FISHERY FOR HALIBUT. Int. Pac. Halibut Comm. Sci. Rep. No. 61. 20p. 1976. SFA 21(4).

[Int. Pac. Halibut Comm., Seattle, WA] The catch and catch per unit effort (CPUE) of halibut in the Canadian and United States setline fishery declined sharply in the Bering Sea and the northeast Pacific during the 1960's and early 1970's. Part of the decline has been attributed to the incidental catch of halibut by the foreign and domestic trawl fisheries which expanded during this period, but only

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recently have estimates of the incidental catch been available to evaluate the effect of trawling on the setline fishery. The results show that trawling reduced the survival of juvenile halibut and, hence, recruitment to the setline fishery. Although yield loss was substantial, trawling accounts for only part of the decline in the setline catch and CPUE. CPUE began to decline when the yield loss from trawling was relatively low. The initial decline in CPUE was expected because the International Pacific Halibut Commission (IPHC) increased the setline catch in the 1950's to test estimates of maximum sustainable yield. However, CPUE continued to decline in the late 1960's and early 1970's, even though IPHC reduced the setline catch. Reduced recruitment apparently was responsible for part of the later decline in CPUE and probably was caused by adverse environmental conditions or reduced spawning stocks, as well as by trawling. To reduce the loss from trawling, IPHC proposed that foreign trawling be prohibited in areas and times when the incidental catch was high. Canada and the United States supported the proposal and, in subsequent negotiations, Japan and the U.S.S.R. agreed to trawl closures. These closures have reduced the mortality of juvenile halibut.

76-001683 Hoag, S. H.; French, R. R. THE INCIDENTAL CATCH OF HALIBUT BY FOREIGN TRAWLERS. Int. Pac. Halibut Comm. Sci. Rep. No. 60. 24p. 1976. SFA 21(4).
[Int. Pac. Halibut Comm., Seattle, WA] Halibut are harvested primarily with setlines in the northeast Pacific Ocean and the Bering Sea, but also are caught incidentally by trawlers that fish for other groundfish. Japanese and U.S.S.R. trawling increased substantially during the 1960's and early 1970's, but reliable statistics on the halibut catch were not reported by the trawl fisheries. Data on the incidence of halibut were collected by sampling the groundfish catch, and the total halibut catch was estimated by extrapolating the incidence to the entire fishery. The results show that the halibut catch by foreign trawlers increased sharply during the 1960's and early 1970's, was highest in the Bering Sea during the winter, and consisted mostly of fish younger than those in the setline fishery.

MISC. TECHNIQUES AND EQUIPMENT

76-001684 Hightower, G. M.; Kimball, K. T.; Bedinger, C. A., Jr. A WATER-POWERED MECHANICAL DEVICE FOR ACCURATELY SUBSAMPLING LARGE NUMBERS OF NEKTONIC ORGANISMS. Trans. Am. Fish. Soc. 105 (4): 509-513. July 1976. SFA 21(4).
[Southeast Res. Inst., 3600 Yoakum Blvd., Houston, TX 77006] A subsampling machine is described which uses a large volume of water to randomly distribute estuarine nektonic collections into 12 equal portions. Samples weighing 4.5 kg to 30.0 kg with fish from 20 to 150 mm standard length can be accurately subsampled in a circular, 76-cm-high, 76-cm-diameter galvanized tub which employs a slightly smaller internal, rotating partitioned basket and nine water jets (six in the bottom and three around the side) for sample mixing and partitioning. Water uplift and manual basket rotation followed by settling result in an accurate random subsample as indicated by chi-square testing.

76-001685 Hughes, S. E. SIMPLE CONTAINER FOR THE COLLECTION AND STORAGE OF OTOLITHS. Calif. Fish Game 62 (4): 306-307. Oct. 1976. SFA 21(4).
[NMFS, 2725 Montlake Blvd. East, Seattle, WA 98112]

76-001686 Provine, W. C. SALT METHOD FOR DETERMINING POND VOLUME. Prog. Fish-Cult. 38 (3): 135-137. July 1976. SFA 21(4)
[Texas Parks Wildl. Dep., Houston 77044] Present methods of pond volume determination are time consuming and laborious. This study describes a simple, quick method for determing water volume in ponds by measuring the change in chloride concentration caused by the addition of a known weight of salt. Mean volume estimate differences between this method and those obtained by multiplying surface area x mean depth and by the flow rate through fill pipes were not statistically significant (/F/-test; 0.01 level).

76-001687 Steele, J.; Rectinwald, H. INEXPENSIVE GRADUATED CYLINDER FOR MEASURING LARGE QUANTITIES OF LIQUIDS. Prog. Fish-Cult. 38 (3): 164. July 1976. SFA 21(4)
[Water Pollution Control Lab., Rancho Cordova, CA 95670] An inexpensive graduated cylinder capable of accurately measuring large quantities of liquids may be constructed using readily available materials. The accuracy of measurement depends on calibration precision. The model tested had a maximum 0.5 percent error.

76-001688 Wurtsbaugh, W. A.; Davis, G. E. LABORATORY APPARATUS FOR PROVIDING DIEL TEMPERATURE REGIMES FOR AQUATIC ANIMALS. Prog. Fish-Cult. 38 (4): 198-199. Oct. 1976. SFA 21(4).
[Lake Cty. Mosquito Abatement Dist., 410 Esplanade, Lakeport, CA 95453] An inexpensive apparatus which provides controlled fluctuating temperatures for flow-through aquariums may be constructed with the following principle components: (1) controlled constant temperature headboxes; (2) electric-timer-controlled solencid valves to regulate water flow from the headboxes; (3) a water mixing chamber and; (4) receiving aquariums.

WATERSHED MANAGEMENT

76-001689 Mrazik, B. R. THE EFFECTS OF LAND USE AND LAND USE CHANGE ON THE YIELDS OF STREAMS IN MASSACHUSETTS. Ph. D. dissertation, Univ. Mass. 233p. 1976. From Diss. Abstr. Int. B Sci. Eng. 37(1), 1976. SFA 21(4)
The effects of land use and land use change on the yields of 42 watersheds in Massachusetts were evaluated over the 20 year period from 1952 to 1971. Land use and runoff relationships were less apparent during the dormant season. Younger forest types were positively correlated with dormant season yields. However, this effect was attributed to associated factors which increase precipitation and reduce evapotranspiration. Older forest variables were inversely correlated with dormant season runoff, reflecting greater interception losses and recharge requirements. Annual water yield was significantly related to the percentage of basin area in urban uses, particularly residential types. Older forest types were generally inversely related to annual runoff, while younger types were positively correlated. A transition from agricultural to urban types was the most predominant land use change in the state during the study period. Most of the increase in urban area was in the light density residential type,

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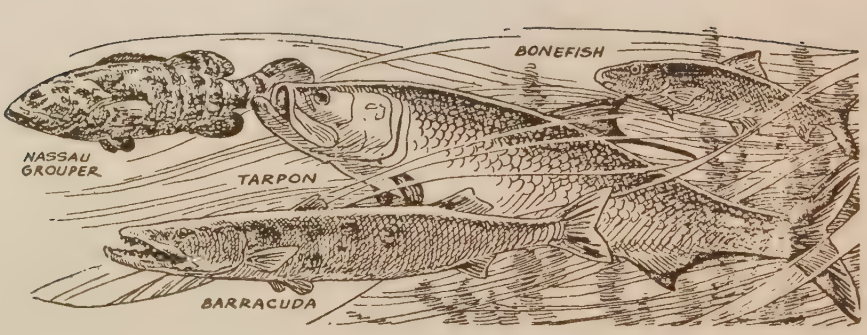
which increased significantly in tree crown closure percentage over the 20 year period. At the same time, decreasing water yield was a predominant trend. Of the 42 watersheds studied, 10 had significant decreases in annual runoff as measured by multiple regression with climatic factors and time as independent variables. Only a single watershed had a significant increase in annual runoff. The changes in annual and seasonal water yield were positively correlated with the loss of agricultural land and inversely correlated with the gains in urban and forested area.--From abstr.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TARPON
BARRACUDA

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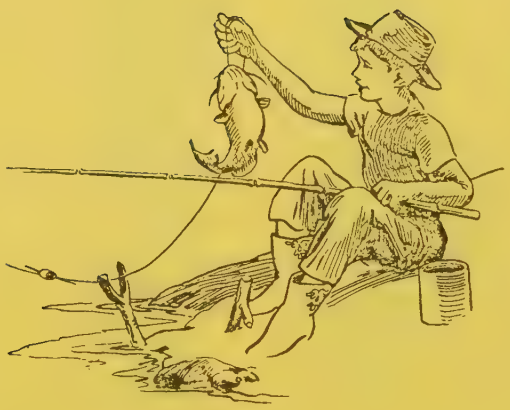

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The following publications were screened for Volume 21. Abstracts not covered by this list are of irregularly published papers, are contributions of cooperating abstracters, or are of separates from publications not regularly received by the Morgan Library of Colorado State University.

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American Midland Naturalist, University of Notre Dame, Notre Dame, Indiana 46556
American Naturalist, The, Univ. of Chicago Press, Chicago, Illinois 60637
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Animal Behaviour, Animal Behaviour Society, Bailliere, Tindall and Cassell, London, England
Annales D'Hydrobiologie, Institut National de la Recherche Agronomique, 149, rue de Grenelle, Paris - 7e, France
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Applied Microbiology, American Soc. for Microbiology, 4715 Cordell Ave., Bethesda, Maryland 20014
Archiv für Fischereiwissenschaft, Westliche Berliner Verlagsgesellschaft, Heenemann KG, Berlin - Wilmersdorf, Germany
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Australian Journal of Marine and Freshwater Research, Commonwealth Scientific and Industrial Research Organization, 314 Albert St., East Melbourne C2, Australia
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Environmental Science and Technology, American Chemical Soc., 1155 16th St., NW, Washington, D. C. 20036
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Eutrophication, Univ. of Wisconsin Water Resources Center Eutrophication Program, 1324 W. Dayton St., Madison, Wisconsin 53706
Evolution, The Society for the Study of Evolution, 1041 New Hampshire St., Lawrence, Kansas 66044
Experientia, Birkhauser Verlag, Basel, Switzerland
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General and Comparative Endocrinology, Academic Press, New York, N. Y.
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Journal of Fish Biology, Fisheries Soc. of the British Isles, Academic Press, Ltd., Berkeley Square House, Berkeley Square, London, England
Journal of Ichthyology (Voprosy Ikhtiologii), The American Fisheries Soc., Scripta Technica, Inc., 1000 Vermont Ave., NW, Washington, D. C. 20005
Journal of Immunology, American Assoc. of Immunologists, Williams & Wilkins Co., Baltimore, Maryland
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